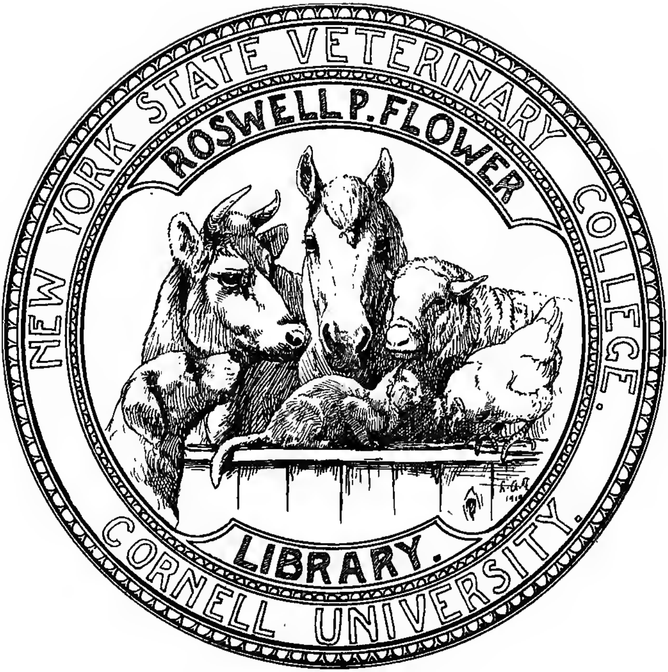
WOUNDS OF ANIMALS

R. H. SMYTHE


NEW YORK STATE VETERINARY COLLEGE.
ROSWELL P. FLOWER
LIBRARY.
CORNELL UNIVERSITY.

Cornell University Library
SF 911.S66

Wounds of animals and their treatment,

3 1924 001 136 559

vet

Cornell University Library

The original of this book is in
the Cornell University Library.

There are no known copyright restrictions in
the United States on the use of the text.

http://www.archive.org/details/cu31924001136559

WOUNDS OF ANIMALS AND THEIR TREATMENT

WOUNDS OF ANIMALS AND THEIR TREATMENT

BY

R. HARRISON SMYTHE, M.R.C.V.S.
Civil Veterinary Surgeon, attached A.V.C.

LONDON
BAILLIÈRE, TINDALL AND COX
8, HENRIETTA STREET, COVENT GARDEN
1918
[*All rights reserved*]
S

PRINTED IN GREAT BRITAIN

PREFACE

WOUNDS of animals, at the time of their origin, do not differ to any extent from those of man; but the conditions under which animals live, combined with their natural opposition to human interference, necessitate a considerable modification of the treatment to be adopted.

Fortunately, nowadays, the rôle played by Nature in the repair of wounded tissues is more nearly realized than in the past, and we, in common with our sister profession, have learnt that our earlier efforts may have been better in intention than in actual fact.

In other words, we realize that we are unable by means of external applications to " heal " a wound; but that, having ascertained the method that Nature herself adopts to secure this end, we may assist her when circumstances arise which may delay or circumvent her object.

Unfortunately, in animals, even were a wound known to be aseptic at its commencement, we should have no opportunity of maintaining this condition. Even with the best possible surroundings animals cannot be kept as clean as the average human being; their bedding and their stables or kennels are always infected, and so secondary infection is quite unavoidable. Hence, wound treatment, from a veterinary aspect, resolves itself into surgical interference or irrigation, with the object of securing drainage whenever natural drainage is inefficient, and resort to antiseptic treatment, vaccine therapy, or surgical operation when the natural method of repair has been altogether overcome.

Doubtless, the greatest enemy to healing is lack of drainage. The various means which we may employ to overcome this difficulty will be discussed later.

In human practice, Carrel's method has recently come into favour in the treatment of war wounds; but, for reasons previously mentioned, its utility as regards veterinary cases is somewhat limited. Nevertheless, continuous irrigation with normal saline or weak antiseptics is one of the greatest aids to drainage, and although it is an old method of treatment, it is again coming into favour, and will, doubtless deservedly, become even more popular in the future.

Antiseptics have for years been the sheet-anchor of the treatment of wounds. Their efficacy has been probably greatly overrated, and it has for long been the vogue to alternately deride them and to proclaim their virtues. There is a useful field for research work regarding the actual effect of their application, both upon animal tissues and upon the invading organisms. Antiseptic treatment is a subject upon which individual opinion is untrustworthy, unless backed by experimental evidence.

In offering this work to the members of the veterinary profession, we do not pretend to present anything startlingly new, or to propound any fresh and original theories, but simply to describe a number of the various types of wounds met with in practice, their course, and the treatment which we have found give the best results.

In conclusion, we have to express our thanks to the author's brother, Captain A. R. Smythe, A.V.C., for his assistance in providing the notes on "War Wounds," and also to Messrs. Baillière, Tindall and Cox for their courtesy and their suggestions as to the arrangement of the manuscript.

R. H. S.

WINCHESTER,
November, 1917.

CONTENTS

CHAPTER PAGE

I. THE PATHOLOGY OF WOUNDS - 1

THE PROCESS OF HEALING - - - 3

THE DERIVATION OF LYMPH 8

II. WOUND INFECTION - - - - 10

WRIGHT'S OPSONIN THEORY - 14

PUS - - - - - 16

III. THE GENERAL TREATMENT OF WOUNDS - 18

THE PRELIMINARY DISINFECTION OF WOUNDS 30

DRESSING DEEP WOUNDS - 38

THE NUTRITION OF WOUNDS 45

BURNS AND SCALDS - - - 47

IV. THE SURGICAL TREATMENT OF WOUNDS - 48

CONTROL OF HÆMORRHAGE 48

SUTURES - - 50

THE USE OF CAUSTICS - - 54

DRAINAGE OF WOUNDS - - - 58

V. SOME COMPLICATIONS AND SEQUELÆ OF WOUNDS 62

VI. WOUNDS OF THE HEAD AND NECK - - 68

WOUNDS OF THE FACIAL REGION 68

WOUNDS OF THE EYELIDS - 68

WOUNDS OF THE EYE - 70

WOUNDS OF THE FALSE NOSTRIL AND ALÆ - 71

WOUNDS OF THE FACE 72

WOUNDS OF THE TONGUE - - 73

CHAPTER PAGE
DENTAL FISTULA 74
SALIVARY FISTULA 76
PRE-AURICULAR FISTULA; DENTIGEROUS CYST - - - 77
WOUNDS OF THE CERVICAL REGION - 78

VII. WOUNDS OF THE TRUNK - 82

PERFORATING WOUNDS OF THE THORAX - 82
WOUNDS OF THE THORACIC REGION WITHOUT PERFORATION - 84
STERNAL FISTULA - 85
COSTAL SINUS - 87
SADDLE AND HARNESS WOUNDS; SITFASTS 88
PERFORATING ABDOMINAL WOUNDS - 89

VIII. OPEN JOINT AND WOUNDS OF BURSÆ AND TENDON SHEATHS - - 95

IX. WOUNDS OF THE LIMBS - 100

WOUNDS OF THE SHOULDER REGION 100
WOUNDS OF THE ELBOW - - 101
WOUNDS OF THE FOREARM - - 103
WOUNDS OF THE CARPAL REGION - - 104
WOUNDS OF THE METACARPAL AND PHALANGEAL REGIONS - - 106
WOUNDS OF THE SHEATHS OF THE FLEXOR TENDONS - 108
WOUNDS OF THE HIND LIMBS - - 109
WOUNDS OF THE STIFLE 110
WOUNDS OF THE TIBIAL REGION 110
WOUNDS OF THE TARSAL REGION 112
WOUNDS OF THE TRUE HOCK JOINT 114

X. WOUNDS OF THE FEET AMONG HORSES AND CATTLE - 120

WOUNDS OF THE CORONET AND CORONARY BAND 129
PANARITIUM IN CATTLE: WHITLOW; CLAW-EVIL - 134

CHAPTER PAGE
XI. FISTULÆ AND SINUSES - 136
INFLAMMATION OF THE BURSA OF THE LIGAMENTUM NUCHÆ: POLL-EVIL - - 140
FISTULA OF THE WITHERS. 148
QUITTOR - 152
FISTULA OF THE INGUINAL REGION - 159
ANAL FISTULA - - 160

XII. CASTRATION WOUNDS - - 163

XIII. UTERINE AND VAGINAL WOUNDS - - 167

XIV. WOUNDS INVOLVING BONE TISSUE - 171
COMPOUND FRACTURE - 171

XV. WAR WOUNDS - - - - - 177

XVI. REMARKS ON THE USE OF VACCINES IN WOUND TREATMENT - - 183

XVII. DIETETICS AND HYGIENE - - - 187

INDEX - - - - - 190

WOUNDS OF ANIMALS AND THEIR TREATMENT

CHAPTER I

THE PATHOLOGY OF WOUNDS

FROM a surgical standpoint wounds may be divided into the following classes:

(1) Simple incised wounds; (2) Lacerated wounds; (3) Punctured wounds; (4) Open wounds; (5) Contused wounds.

Distinction must also be made between wounds which are confined to the skin, and known as *skin* wounds, and those which penetrate muscle and possibly other structures, and are referred to as *flesh* wounds.

Wounds may also be *aseptic,* when they are free from micro-organisms; *infected* or *septic,* after they have become invaded.

All, however, with the exception of a few operation wounds, may be considered as being infected in a greater or lesser degree from the time of their origin.

1. **Incised wounds** have clean-cut, regular edges. They may occur accidentally from injuries inflicted by glass, nails, sharp implements such as ploughshares; from kicks, barbed wire, malicious injury, and from various other causes.

2. **Lacerated wounds** have torn, irregular edges, and portions of skin, muscle, and various neighbouring tissues, may have been torn completely away.

They are commonly caused by collision with more or less blunt objects, such as a stake, the end of a shaft, door fasteners, gates, or walls. Barbed wire and projecting nails are frequent offenders, whilst many cases arise from kicks and from contact with the horns of a bullock.

3. **Punctured wounds** are of small or moderate diameter, and penetrate the skin and subjacent tissues more or less deeply.

They may be caused by sharp-pointed objects, such as stable forks, spikes and nails in walls, doors, or mangers. Punctured wounds of the feet are commonly the result of treading on nails or the toe-clip of a horseshoe. They are produced by external injury and are directed from without inwardly, in distinction to sinuses or fistulæ, which have their origin somewhere within the body and open outwardly.

4. **Open wounds** are gaping wounds which are usually visible to their depths. They may arise from loss of tissue, as from the surgical removal of neoplasms and after the radical operations for poll-evil or fistulous wither, or may be caused by collision with external objects.

5. **Contused wounds** may be of any of the preceding types, and are attended by extravasation of blood or lymph into the tissues involved. They are usually the result of kicks, falls, or collisions. Broken knees afford an example, whilst wounds caused by pressure of the pad or collar are usually of this type.

THE PROCESS OF HEALING.

Wounds heal by one of four methods:

1. First intention.
2. Granulation, sometimes referred to as *second intention.*
3. By the formation of a scab, under which healing takes place.
4. By the union of two granulating surfaces.

Healing by First Intention.—This mode of union occurs but rarely in veterinary practice. The conditions necessary for its accomplishment are as follows: The edges or surfaces of the wound must be kept in apposition, there must be freedom from bacterial infection, or else such a slight invasion that the phagocytes may be able to destroy the organisms before they have damaged the tissues.

Large wounds left to Nature never heal in this manner; small wounds may occasionally do so.

The actual process of healing by first intention will be described later, as it is merely a variation of the method now to be described.

Healing by Granulation.—If we examine a wound a few hours after hæmorrhage has ceased, we find the surface moist and exuding a clear, straw-coloured, limpid fluid, at first appearing in small drops, which later coalesce to entirely cover the wounded surface. The escape of this fluid, as will be shown later, is, of course, partly mechanical and arising from injury to the vessels, but by far the greater part is derived from the escape of lymph, which normally issues from capillaries, increased in quantity by the hyperæmia which becomes established in the wounded tissues. The severing of the intercellular spaces and the lack of resistance thus caused probably plays a part in the production of an increased flow of lymph for a short time subsequent to the infliction of the wound.

If we examine the surface on the following day we shall observe that it has become partly obscured by a more or less opaque fluid which has taken the place of the clear exudate.

Twenty-four hours later the opacity will be much more pronounced, and the fluid will have assumed the creamy, opaque appearance characteristic of "pus." On wiping away a little of this fluid, we see that the surface of the wound has altered in appearance, and that it is covered with vascular-looking protuberances each of the size of a pin's head. These are the commencing "granulations."

The presence of pus indicates that leucocytes (mostly of the polymorphonuclear variety) have migrated from the small vessels. It also points to the fact that the wound has become infected, either at the time of or since its production, by bacteria.

The leucocytes are brought through the vessel wall by the extraordinary attraction which pyogenic bacteria have for them, and by virtue of their power of amœboid movement, which permits of their penetrating the cementing substance between the endothelial cells.

"Negative chemotaxis" is exhibited by certain organisms, such as the *B. anthracis* and *B. œdematis maligni*, which actually repel the leucocytes. Hence, foci of infection containing these bacilli exude a thin serous fluid which lacks the opaque appearance common to pus.

A few days after the first appearance of pus in the wound, the peripheral edges will present a dry, shaded appearance, as though they were coated over with a thin film. This indicates that new epithelium has commenced to grow over the surface of the granulations.

In course of time this film extends farther over the wound, whilst a shrinking occurs in the depth of the granulation tissue, which has the effect of bringing the edges closer together.

Eventually the whole of the wound becomes covered with epithelium, which soon assumes a horny appearance, forming a "scar," which in course of time contracts until in a favourable case practically no mark of the previous wound exists.

The Process of Granulation.—A section across a young granulation shows spherical or spindle-shaped cells, capillaries, and usually leucocytes and bacteria.

It is well at this stage to consider briefly the histology of areolar connective tissue. It is composed of a ground substance or matrix containing mucin in which course bundles of fibres cemented together by the same matrix material. These bundles run in various directions, and branch and intercommunicate. The separate fibres themselves, however, show no branching. The jelly-like matrix also contains the corpuscles of the tissue, mostly adherent to the fibres.

The cells which are visible in the section of granulation tissue are mainly fibroblasts derived from the connective tissue. When these connective-tissue corpuscles are irritated, as by the action of the air, they leave the fibres, become free in the matrix, and swell until they become spherical. They then begin to multiply and build up the little masses of soft cell tissue which represent the early granulations.

The blood-supply necessary to the nutrition of these new cell masses is derived from capillaries, which develop in their midst from the existing capillaries by a process which we may regard as "budding." On the existing capillaries small buds develop, which grow outwards, and eventually, upon attaining a certain length, either bend backwards to rejoin the capillary, forming a loop, or unite with a similar outgrowth from the same or another capillary, in which case the lumen becomes continuous. The new vessels are composed of a single layer of nucleated endothelium. Arterioles and veins develop in the same way from existing arterioles and veins, the elastic and other coats, in the case of an arteriole, gradually extending over the endothelial bud.

This multiplication of corpuscles is entirely dependent upon irritation, as exemplified by lack of protection and the irritant effect of exposure to air.

As long as the irritation persists granulation proceeds, and unless a means of protection were provided, healing would never progress beyond this stage.

What actually happens is that the endothelium grows over the granulations from the edges of the wound, whilst at the same time the cells in the depth obtain protection from the layers of granulation tissue formed on their surface.

In some cases, such as when the wound is so situated that constant irritation persists, as when it is in close proximity to a joint, growth of epithelium over the surface of the wound is hindered, granulation becomes uncontrolled, and thus excessive, and produces the condition commonly referred to as "proud flesh."

The cells in those portions of the granulation tissue which are sheltered cease to multiply and become spindle-shaped. At the same time intercellular tissue begins to appear, at first homogeneous and later fibrillated, the majority of the fibroblasts which built up the granulation tissue becoming adherent to the fibres.

Newly formed fibrous tissue tends to contract, and as this occurs the new vessels disappear under the pressure, and the scar becomes whiter and gradually assumes smaller dimensions. If the wound has been of considerable extent, the contraction of the scar tissue exerts distinct traction upon the surrounding tissue.

Scar tissue is always devoid of sebaceous glands and hair follicles. In some cases granulation tissue does not develop into scar tissue. Owing to excessive irritation, the destructive effects of bacterial invasion, lack of blood-supply in a situation such as the poll, which is normally deficient in blood as compared with other parts of the body, or to pressure on the vessels from excessive granulation, the process of healing is interrupted and an ulcer is formed. In this case the granulations contain giant cells, and may show signs of fatty degeneration. The pus which exudes is thin and transparent, and contains but few leucocytes.

If the condition results from lack of the necessary blood-supply, stimulation of the surface by irritant antiseptics or counter-irritation, such as hot fomentation or local blistering, will stimulate the circulation through the granulations. Leucocytes will again migrate from the vessels, and the discharge will again become opaque.

Healing by First Intention.—This resembles healing by granulation in every respect excepting the small amount of new tissue formed. After the first few days the irritation ceases, owing to the covering of the edges at their junction by epithelium.

Healing under a Scab.—In this case the wound becomes covered by a layer of coagulated lymph, which usually contains débris of blood-corpuscles and frequently micro-organisms. If the wound beneath the scab be aseptic, healing proceeds with moderate granulation and comparatively rapid ingrowing of epithelium. If, however, micro-organisms are imprisoned beneath the scab, pus-formation and destruction of tissue proceeds usually with ulcer-formation.

Attempts to produce an artificial scab by the use of collodion, gelatine, etc., are frequently made in practice, but are not free from danger owing to the risk of including pyogenic and other organisms.

Healing by Union of Two Granulating Surfaces.—Frequently two granulating surfaces, if brought together and kept in apposition, unite. The conditions necessary are perfect and prolonged contact, drainage, and asepsis.

THE DERIVATION OF LYMPH.

The composition of lymph and its rate of flow through the capillary walls is dependent upon several factors:

1. The pressure at which the blood is circulating through the capillaries.

2. The difference between the pressure of the blood in the capillaries and that of the fluid in the intercellular spaces, which normally contain lymph in course of transit between the capillaries and lymph vessels, and particularly by osmotic interchanges resulting from variation of the composition and degree of concentration of the fluids contained in these two situations.

3. The degree of permeability of the capillary walls. This varies according to their position in the body, to the extent of injury they may have sustained, and to the degree of inflammation existing.

4. The selective agency of the cells of the capillary wall.

The flow of lymph in a given area may be increased—

(1) By raising the pressure of the blood in the capillaries. This may be brought about by obstructing the outflow of blood from the veins by compression, by the local application of counter-irritants, or by intravenous injection of certain "lymphagogues," as saline or sugar solution. These substances exert osmosis through the capillary walls, and by attracting water from the tissues into the blood-stream increase the volume of blood circulating through the capillaries.

(2) By the local application of saline solution of greater

concentration than that of the blood-plasma, and by the oral administration of sodium citrate, which renders the blood-plasma more fluid and increases its power of penetrating the capillary walls.

(3) By increasing the permeability of the capillary walls by injuring their vitality.

CHAPTER II

WOUND INFECTION

WITH the exception of a few operation wounds which have been produced in sound tissues with strict observance of the principles of asepsis, all wounds may be regarded as being infected from the time of their occurrence. In fact, there are reasonable grounds for believing that such a thing as an aseptic wound does not exist in the literal acceptance of the term.

The skin of all animals is a natural habitat of bacteria, and this fact applies more markedly to that of the domesticated animals, upon and within the outer layers of which are present many types of pyogenic and other organisms, or spores, awaiting the first opportunity to enter the deeper tissues. It is not to be wondered at that antiseptic rather than aseptic surgery is practised to such an extent by veterinarians.

Apart from the skin itself, the liability of the domesticated animals to infection from external objects is far greater than in human practice. Owing to the conditions under which they are kept, they are constantly surrounded by filth; they lie on bedding frequently saturated with excreta, and in the case of the equine members are daily subjected to the friction produced by infected harness. Again, accidental injury is of much more common occurrence, and wounds produced in this manner are practically always infected by contact with the objects which caused them.

The various organisms which are met with in wound infection are very numerous. They include very many different types of staphylococci and streptococci; *B. pyocyaneus*, *B. œdematis maligni*, *B. tetani*, *B. coli*, and, in certain cases, *B. necrosis*, bothryomyces, or, more commonly in cattle, actinomyces. *Staphylococcus albus* and *S. aureus* are common to practically all infected wounds, even in cases where the primary infection is due to the presence of other organisms. They are commonly distributed throughout the wound, and are frequently to be found in the substance of the new granulation tissue, even at a considerable depth.

B. coli and *B. pyocyaneus* are common in many abscesses, together with staphylococci, streptococci, or both. *B. coli* is a natural inhabitant of the digestive tract, and owing to the frequent contact of the skin with fæces, particularly in the anal and perineal regions, it is very common in wounds of these parts; but it may nevertheless sometimes be observed in situations far removed from the anus, as in cases of poll-evil.

B. œdematis maligni may infect deep wounds, as it has a marked preference for connective tissue and is anaerobic. It is occasionally met with in most of the domesticated animals, with the exception of bovines Dogs also seem to possess a certain degree of natural immunity. It always appears to be associated with other organisms, and does not generally give rise to serious trouble unless the number of bacilli gaining entrance is fairly large, and the results are in this case usually fatal.

B. tetani, at any rate in the spore form, like the last organism, is an inhabitant of soil and dust, and is to be found in agricultural land in direct proportion to the degree of cultivation. Horses working on market gardens and on land dressed with sewage material are particularly liable to become affected with tetanus. It is an anaerobic organism, and flourishes best in deep punctured wounds which are more or less inaccessible to air; in fact, tetanus bacilli will not multiply unless they gain entrance to subcutaneous or deeply seated tissues. Tetanus cannot be produced by inoculating a scarification.

There is good reason to believe that the anaerobic bacteria largely owe both their existence and their capability of producing toxins to their cohabitation with organisms of the aerobic species, and that the coli and streptococcus groups are largely concerned in the development of acute septic processes within and around wounds.* The chief aerobic bacteria which assist in this symbiotic arrangement are undoubtedly certain aerobic streptococci.

The production of gas in wounds and the tissues adjoining them is usually the work of anaerobes existing as a secondary infection to aerobic organisms. *B. œdematis maligni*, *B. coli*, streptococci, and staphylococci, are frequently present. This class of wound usually possesses a very putrid, offensive odour.

Tetanus bacilli, in particular, in wound infections are dependent upon the presence of other organisms for their existence, and especially as regards their capability of producing toxin. By themselves they are of low pathogenic power, as is indicated by the fact that relatively large quantities of tetanus bacilli, previously freed from their toxin, have been inoculated into susceptible animals, after due precautions have been taken to exclude other organisms, without producing any symptoms of tetanus.

B. pyocyaneus is usually associated with wounds exuding blue or greenish tinted pus, which has the peculiarity of turning green on contact with alkalies and red with acids.

---

* See Goodby on "A Natural History of Septic Wounds," *Lancet*, September 30, 1916.

Various spirillæ, some of comparatively large size, and many types of bacilli are common in infected wounds of the mouth, in which and around the teeth they naturally exist. They usually produce a very offensive odour. Cases of ulcerative stomatitis in carnivora are commonly infected by these organisms; frequently *B. necrosis* is present in addition, with many cocci of various types.

Bothryomyces and actinomyces appear to be commonly present in certain land, whilst animals on neighbouring farms may never show signs of infection. Bothryomycosis is often a sequel to the operation of castration, and on some lands the danger of "scirrhous cord" occurring subsequently is far greater than on others. Apart from the spermatic cord, other parts of the body are liable to invasion, particularly the point of the sternum and parts which are subject to harness friction, such as the shoulders where they underlie the collar.

Actinomyces may invade wounds of the tongue, mouth, or other portion of the digestive tract, in addition to bone and superficial tissues. The organisms have frequently been found in vegetable matter and associated with straw and grain, and it has been supposed by various observers that infection of the tongue and jaws is caused through wounds occurring during the mastication of these substances. As many cases occur under circumstances not attended by these conditions, the theory is not at all convincing. Possibly infection is conveyed by saliva and other discharges from affected animals which infect the food material of others. A sequence of actinomycosis cases on one farm is very common, particularly at the time when young bullocks are changing their teeth. This appears to be the common path of the organisms to the maxilla and possibly to the lymphatic glands of the pharyngeal region.

B. necrosis is a frequent inhabitant of wounds, particularly of fistulæ and sinuses, such as quittors, poll-evil, and fistulous withers. It also is the cause of the disease affecting the gums and mouths of calves, usually described as " bacterial necrosis."

A large outbreak of the disease in Cornwall was caused by feeding calves on dry, shaly ground with a shortage of grass, when the organisms invaded the abraded gums.

A type of bacterial necrosis is also very common at the present time amongst the horses employed by the army in France, and will be described in another chapter.

We shall next briefly discuss the methods Nature adopts to minimise the effects of wound invasion by bacterial organisms.

WRIGHT'S OPSONIN THEORY.

Wright proved that there existed in blood-serum certain substances which caused the bacteria to be more readily ingested by the leucocytes. These substances he termed " opsonins " (feast-preparers).

It appears from experiment that the leucocytes themselves are not rendered, so to speak, any more voracious. Leucocytes which greedily attack organisms in the presence of their own particular opsonin do not possess any abnormal appetite for organisms of other species which lack opsonin. In fact, the phagocytic tendencies of leucocytes do not appear to vary to any great extent. The leucocytes of an emaciated animal will ingest as many bacteria in the presence of their own particular opsonin as will those of the most robust. A distinction is drawn between " normal " and " immune " opsonin. The former is present in the blood of a normal susceptible animal, the latter is present in the blood of one that has successfully resisted bacterial invasion. Normal opsonin is destroyed by heat, whereas the immune opsonin is thermostabile. They therefore appear to be totally different substances.

There exist in blood-serum substances known as "bacteriolysins," which have the power of destroying bacteria by actually dissolving them. This property is lost soon after the serum has been exuded.

The bacteriolytic action is dependent upon the presence of two bodies: one, the "complement," is present in all serum; the other, the "amboceptor," is produced during the processes of immunity.

The complement is actually the solvent, but the amboceptor has the power of linking the complement to the bacteria, and thus allows the bacteriolytic action to come into play.

To the surgeon, who desires satisfactory wound healing, the production of opsonins is a matter of prime interest. It is believed that they are mainly produced in subcutaneous and intermuscular connective tissue, and in the muscles themselves. The plasma extracted from minced muscle contains a greater proportion of opsonin than does blood-plasma.

The greater the pressure in the bloodvessels, the greater is the amount of the lymph which bathes the wound and correspondingly the quantity of opsonin. The endothelial cells must also be assumed to possess selective powers over the substances which they allow to pass through their walls, in common with the selective powers possessed by endothelial cells in other situations. Increase in the rate of osmosis of saline and other materials through the cell walls, artificially produced, also probably increases the liberation of opsonins which it is difficult to disentangle from them.

PUS.

The most visible effect of the invasion of a wound by micro-organisms is the discharge of pus. "Laudable pus" is the term applied to the discharge from an infected wound or abscess in which the healing process is taking a favourable course. It is a thick, creamy, opaque, whitish fluid, often slightly blood-stained, possessing a faint, sickly odour and an alkaline reaction. It is largely albuminous, and contains salts as they occur in the blood. Unlike most albuminous fluids, it does not coagulate. On standing, the white corpuscles sink and leave a clear supernatant fluid, the liquor puris.

Pus-corpuscles are leucocytes, mostly polynuclear, in various stages of degeneration. A certain number still show powers of amœboid movement and contain ingested bacteria, but the majority are dead.

The bacteria are distributed throughout the pus. Many are dead, and a large number are more or less degenerates, but a certain proportion are active. By far the most virulent of the bacteria present are contained in the granulations and in the cover afforded by the spaces between them. Pus has no absorbent action. A splinter of bone, a thorn, or a barley awn, imprisoned in a wound and surrounded by pus, will remain intact. The same bodies in granulation tissue would become eroded, and would disappear in the course of time.

If pus has no means of exit from a wound or abscess cavity, it becomes "inspissated." In other words, the fluid portion is absorbed from it and the solid portions become partly fatty and desiccated, and crystals of cholesterine become deposited in it. Later calcification sets in, and eventually a substance of a stony nature is produced. As a rule, whilst the pus is becoming inspissated the surrounding tissues are becoming organized, owing to the formation of granulations and their subsequent conversion into fibrous tissue.

In other cases, where the resistance to the invading organisms is slight—that is to say, where the opsonic index is low—the pus may not present this creamy appearance. It is then clear and straw-coloured or even darker, frequently contains flocculi, and has an offensive smell. This type is referred to as "serous pus." It is commonly associated with ulcers and wounds which are healing but slowly, also in infection by certain organisms, as *B. anthracis*, which appears to repel leucocytes.

Occasionally one meets with a form sometimes referred to as "curdy pus." It somewhat resembles serous pus, but contains whitish curds or has strings of coagulated fibrin floating in it.

Serous pus is spoken of as "ichorous" when it is thin and acrid, "sanious," when thin and bloody, and "grumous" when it contains partly coagulated blood.

Abscess-formation, when not set up by internal infection such as strangles, usually results from lack of drainage and from allowing deep wounds to heal at the outside before the bottom has closed. *Corpora oryzoidea* are spherical or ovoid bodies, greyish in colour, and ranging in size from that of a grain of rice to that of a haricot bean. They are often present in large numbers in chronic inflammation of bursæ, as in cases of poll-evil, and in long-standing cases of bursitis affecting the limbs.

CHAPTER III

THE GENERAL TREATMENT OF WOUNDS

Examination of the Wound.—The first steps in the examination are to note the nature and type of wound, its relationship to important structures such as joints, bursæ, tendon sheaths, or bloodvessels, and its extent, direction, and depth.

What on first sight is apparently a clean, incised skin wound may upon manipulation reveal a deep puncture at its depth or extend to comparatively deeply seated structures. Foreign bodies such as glass, skin, pieces of wood or metal, and various other substances, must be sought for and removed. Careful exploration is necessary wherever there is separation between the skin and subcutaneous tissues.

When a wound exists in the neighbourhood of a joint or tendon sheath, the possibility of the escape of synovia must be borne in mind. Such a discharge may not only issue from wounds in close proximity to an articulation. Injuries in the tibial region, even when well below the capsule of the stifle joint, may communicate with the synovial cavity either by extension through infection or by undetected sinuses. A clear, straw-coloured, frothy discharge with a tendency to coagulate should always raise suspicion of synovial escape, from whatever position it may be observed to issue, and steps should immediately be taken to trace it to its origin.

In the majority of wounds of small dimensions, primary hæmorrhage has usually ceased before the surgeon is called upon to attend them, and in other cases the means to be adopted to bring about its arrest require but brief description (see p. 48). Severe secondary hæmorrhage rarely occurs in wounds, unless fairly large vessels have been severed, as the spermatic artery, or unless the part is one which may be subjected to excessive movement or further injury. Secondary hæmorrhage as the result of suppuration or necrosis affecting the vessels is an uncommon sequel in veterinary practice, with the exception, perhaps, of wounds of the facial sinuses and nasal cavities such as are produced by the operation of trephining. In these cases mechanical injuries or necrosis of the turbinated bones may set up very severe hæmorrhage.

General Treatment.—We must, of course, in all cases consider that the wound has become infected with micro-organisms, in the absence of which healing would be uninterrupted. The question then arises as to what is the best means of destroying as many of the invading bacteria as possible, of preventing the multiplication of those which resist our efforts, and of avoiding further infection. Incidentally, we must direct our efforts towards removing or neutralizing any toxins excreted by the organisms before they can do harm either at the seat of the injury or after their absorption into the body.

There exist two schools of teaching with regard to the bacterial aspect of wound treatment.

One body of observers advocates the disinfection of every wound, followed by the continuous or intermittent application of antiseptic fluids. The other body strongly deprecates the use of disinfectants and antiseptics, and advocates what may be described as "Nature treatment"—in other words, the assistance of those physiological processes by which healing normally occurs. Both theories have been pushed to extremes, and the probability is that both are partly right and partly wrong.

The contention against the use of disinfectants is that they destroy the leucocytes and alter the character of the lymph and tissue cell contents, thereby lowering the powers of resistance without actually lessening the infection by any appreciable extent.

The argument against the natural method of healing is that it is inefficient, that the body unaided is incapable of combating infection, and that the course of repair is prolonged.

There is certainly a considerable amount of evidence to the effect that the whole of the organisms contained within a wound cannot be killed by the use of disinfectants unless the wound happens to be of very small extent and comparatively superficial. Every practitioner can call to mind cases of a similar nature in which the one under most careful antiseptic treatment has developed unfortunate sequelæ—possibly tetanus has set in—whilst the other, with but little attention, has made a favourable recovery. It is a matter of daily experience that wounds continue to suppurate under most rigid antiseptic treatment, and certainly do not pursue the course we should expect them to do, did antiseptics actually possess the power of limiting bacterial growth that has been attributed to them.

There can be no doubt that when antiseptics are applied to a wound in a sufficient degree of concentration to destroy the infecting organisms they are also responsible for a considerable amount of cell destruction in the surface layers, and thereby provide fresh soil in which bacteria may flourish. The continuance of infection from air and dust and contamination by inexperienced dressers is one of the difficulties which beset the veterinary surgeon in particular. Another point which arises in the discussion of antiseptic treatment is the power of penetration which these agents possess with relation to their capability of destroying infecting organisms.

Granulation tissue presents a very irregular surface marked by deep pits and fissures possessing endless ramifications coursing between the separate masses. Apart from this, the granulations are covered on all surfaces and in all their interspaces by a tenacious albuminous fluid, the lymph.

What effect will the application of an antiseptic fluid exert upon the bacteria thus protected?

The discharges which issue from a wound after granulation has commenced are albuminous and of a tenacious consistency, and have a marked tendency to resist admixture with other fluids.

If a test-tube be partly filled with fresh pus and a little water added, the latter will be found to remain upon the surface, and a very considerable amount of shaking will be required before anything approaching a uniform mixture of pus and water can be obtained. In point of fact, it is practically impossible to sterilize pus by shaking it with an antiseptic.

A very large number of antiseptics coagulate albumen, and in this quality lies the reason of their power. When a solution of one of these substances is brought into contact with the albuminous layer which protects the wound it simply coagulates the entire surface, and further imprisons the bacteria which still remain in the interstices of the granulations, and, by minimizing the supply of oxygen to the depths of the wound, facilitates their multiplication. Practically the only organisms which are destroyed in this operation are a small proportion of those free in the pus, many of which are degenerates.

There are a considerable number of antiseptics which do not possess this property of coagulating albumen, but none of them seem capable of penetrating to the depths of the wound and destroying the organisms embedded therein.

The best opportunity of getting rid of the infecting bacteria is in the early stages, within a few hours of the injury being committed, as at this time the lymph is more fluid and the actual area of the wound surface is then at its minimum, granulation not having commenced.

If the wound be thoroughly cleansed at this time, wiped dry, and dressed with a solution of some antiseptic which will destroy the greatest number of organisms with the least amount of injury to the tissue cells, and if the wound be subsequently protected by suitable dressings from outside contamination and properly drained, good results ought to follow. But the fact remains that our anticipations are not always realized. Simple incised skin wounds are usually successfully treated in this manner, but the majority of wounds met with in veterinary practice are more or less deep, lacerated, and have irregular floors, into the cracks and crevices of which antiseptics do not penetrate, and in these enough bacteria remain active to multiply and flourish.

Advocates of the "Nature treatment" tell us that during the early stages of wound healing we should carefully avoid antiseptics.

At this time the tissues are hyperæmic, capillaries are severed, and lymph, with its contained opsonins, is then being secreted at its best. The degree of infection is now comparatively slight, and provided that the opsonic index of the patient is high or normal towards the particular organisms present, the leucocytes will, unaided, in a comparatively short time, have ingested a far greater number of bacteria than could possibly be destroyed by antiseptics. The number of phagocytes which enter the lymph to engage in battle with the invading organisms converts the lymph into laudable pus, and from the present-day point of view nothing could be more satisfactory.

Cases, however, occur in which the opsonic index is not sufficiently high to enable the phagocytes to combat the infection. In a few of these undoubted assistance is derived from the use of autogenous vaccines, either prepared from cultures of all the bacteria present or from cultures of bacteria which are supposed to have symbiotic relations with the actual offending organisms.

But there are many instances in which the resistance to infection is naturally very low, and in which vaccine treatment would be of no service, such as in infection by bacillus of malignant œdema, and various other organisms.

Under these circumstances it remains either to allow the animal to become seriously ill, die, or become eventually of little value, or to resort to extreme measures involving the use of strong disinfectants, caustics, or surgical operation, measures which will be discussed later.

Practice and theory both lead us to believe that after the removal of all foreign substances from a wound the best routine course to adopt in the majority of wounds is copious and prolonged flushing of the wound with normal saline solution at body temperature. The process may be repeated at intervals of from one to several days, according to the rate at which the discharges accumulate.

Attention should at once be directed towards securing efficient drainage, and one should not hesitate to enlarge a wound or provide counter-openings in any case in which there is reason to suppose that there will be any hindrance to the escape of discharges. A large wound from which pus can easily escape always heals more rapidly than a small one in which the discharges are confined.

The skin surrounding the injury needs some attention. It is generally considered necessary, but is more probably unwise, to clip off the hair in the neighbourhood of the wound. However carefully this operation is performed, short hairs invariably enter the wound, and, being seldom completely removable, act as foreign bodies and convey infection.

The better plan is to paint the surrounding area with tinct. iodi or a solution of iodine in petrol, and then to apply a light dressing of an antiseptic ointment, such as weak iodine ointment or one containing essential oils, tar, or other substances which will keep insect pests at a distance. Irritation and blistering of the surrounding skin by the action of discharges is also avoided. If it be considered advisable to remove the hair, the wound should first be plugged with wool, which may be removed after all loose hairs have been wiped away.

Secondary infection often occurs from the application of unclean hands or infected instruments, such as probes or forceps, and from the insertion of dusty and unsterilized dressing materials, such as tow.

In those cases in which no attention is paid to the surrounding skin, bacteria are washed into the wound at each dressing.

Saline dressings, especially if rendered slightly alkaline, exert an osmotic influence, and considerably increase the exudation of fluid from the tissue cells.*

Normal saline solution or a very slightly hypertonic solution, apart from its cleansing properties, presents the ideal medium for the activity of phagocytes. Solutions of greater concentration have, in all probability, an adverse effect on wound healing, in spite of the many claims advanced in their favour of late years. We must suppose in the first place that the cell wall is, from the view of osmosis, a semi-permeable membrane through which certain substances, notably salines, water, and to a lesser extent colloids, can pass under pressure.

---

* See "The Mechanism of Saline Dressings," by Kenneth Taylor, M.A., M.D., *Brit. Med. Journ.*, May 22, 1916.

The first effect of surrounding the cell with hypertonic solution is to increase the saline content of the cell, and to lessen the concentration of salt in the solution. In other words, salt passes from the solution into the cell, whilst water passes from the cell into the solution. Whilst this exchange is being effected, a similar osmotic interchange is taking place on the other side of the cell, between it and the blood or body fluids. The salt which enters the blood or lymph circulation is quickly carried away, and eventually there comes to be a maximum concentration of salt in the cell, with a steady rate of exchange with the blood-stream for water, which enters the cell. This maximum concentration will be midway between the concentration of the dressing solution and that of the blood.

At the same time, the albuminous contents of the cell are exerting osmotic attraction for the water of the dressing, and the albuminous substances are diffusing outwards at a slower rate owing to the size of their molecules. The final stage is that the concentration of salt in the cell, combined with the attraction set up by the albuminous contents, results in the drawing of an excessive quantity of water into the cell, giving rise to a condition of œdema.

Apart from this, it is probable that a concentrated solution of sodium chloride is inimical to the phagocytic power of the leucocytes and the beneficial action of the opsonins.

Normal saline solution, however, providing it is used at intervals and not continuously, has none of these disadvantages. Albuminous substances, including in all probability opsonins, diffuse outwards, although slowly, into the plasma, and with the phagocytes are contained in a medium eminently suitable to the performance of their operations. Œdema of the tissues, with consequent lack of resistance to infection, only occurs when the bathing is very prolonged. As before mentioned, in the case of hypertonic and faintly hypertonic saline solutions, the increased flow of water and salt induced brings with it albuminous matter which cannot be altogether disassociated from saline material. The increase in the secretion of opsonins is as great when normal saline solution is used as in the case of hypertonic solutions.

A plentiful supply of blood to the wounded surface is a matter of first importance; the greater the pressure in the capillaries, the greater will be the output of lymph. It is a noteworthy fact that wounds occurring in parts of the body where the blood-supply is meagre are slow to heal. Granulation is slow, the supply of lymph is scanty, and the wounds take on an unhealthy appearance and discharge a thin, serous pus.

Counter-irritation is of service when applied to wounds in which the healing process is retarded, even when the degree of infection is not severe. The same results are attained by Bier's treatment when this is applicable. Both methods produce local hyperæmia.

Dry dressings are of service in shallow wounds, and are applied either with the object of keeping the opsonin-bearing lymph in contact with the granulations or for the protective effect they exert during the later stages of healing, when they considerably assist in stimulating the growth of epithelium. In deep wounds they accumulate on the surface and retard the formation of granulations by virtue of the protection they afford, and hence are contra-indicated.

The presence of air has a marked influence on healing, owing to the fact that the majority of the bacteria which infect wounds are anaerobic.

Wounds which are open to the air or have at the most a protective covering of gauze heal much more readily than those which are swathed in thick bandages, and the types of the infecting organisms are limited in number. On these grounds fault must be found with the general practice of suturing wounds. Excepting the case of operation wounds, which we imagine to be aseptic, and in which healing by first intention is aimed at, the act of suturing encloses countless living bacteria in surroundings particularly suitable to their multiplication. This refers especially to anaerobic organisms, which constitute the greater number of bacteria commonly found in wound cavities, including the *B. tetani* and *B. œdematis maligni.* Moreover, when wounds are closely sutured, drainage cannot be so effectively maintained, and the final scar is more noticeable, owing to the habit that sutures have of tearing out and lacerating the edges of the wound.

They also have the disadvantage that unless they are composed of specially prepared waterproof material or of wire or catgut, they act as miniature setons and convey infection into the wound.

There are very few accidental wounds of any size that will heal by first intention, even if the sutures will remain in position for a sufficient period.

At the same time, wounds do occur which require suturing, as when the extensor muscles of the forearm are ripped and hang below the knee. In such a case, unless the damaged tissues were supported by sutures or other means, excessive granulation would occur, and if healing eventually occurred, considerable deformity would result.

In any other case than a flap wound, such as is described above, it is advisable to remove sutures after

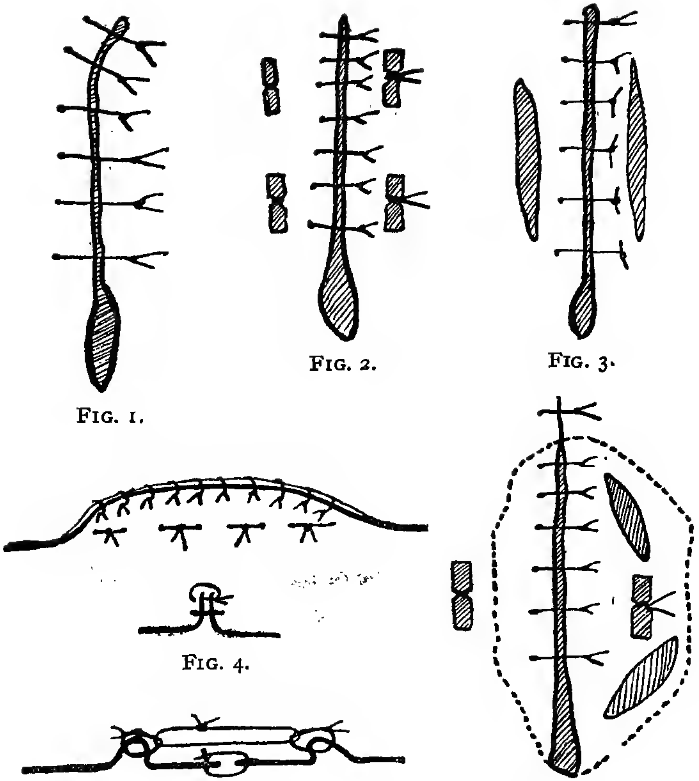


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Figs. 1-6.—Diagrams illustrating Various Methods of Suturing Wounds.

(1) Interrupted sutures, with lowest extremity of incision unsutured to provide drainage. (2) Interrupted sutures and peg or quill sutures for support. (3) Interrupted sutures, assisted by lateral skin incisions. (4) Deep sutures inserted longitudinally; edges united by close interrupted sutures. (5) Diagram to illustrate "looped" sutures of relaxation. (6) Method employed to suture an oval non-granulating wound of the buttock after dissecting flaps of skin free. The dotted line indicates the original borders of the wound.

twenty-four or, at the longest, forty-eight hours, and to treat the wound subsequently as an open one. This method produces more satisfactory results than prolonged suturing. The edges of the wound eventually come into perfect apposition, and the scars which otherwise would remain as the result of sutures tearing out are avoided.

In spite of careful treatment, one occasionally meets with a wound which obstinately refuses to heal and tends to end in sinus-formation. The first thought is, of course, of the presence of necrosis or a foreign body in the depth of the wound. Sometimes a small unsuspected sinus will be discovered by careful probing, which will lead to diseased bone, fascia, or tendon, or to a slough which has not yet been cast off from the tissues. In other cases drainage may be imperfect, circulation may be feeble, or from lack of irritation epithelium may have increased out of all proportion to the extent of the granulation. Should the cause still be undetected, it is advisable to make a microscopical examination of the discharges and determine the nature of the infection. Frequently one particular type of organism predominates, against which the defences of the body are inefficient, and we may then derive assistance from vaccine-therapy.

The routine treatment of ordinary wounds may then be summarized as follows: (1) The provision of drainage; (2) maintenance of blood-supply; (3) admission of air; (4) removal of pus and cleansing of the wound by the use of harmless fluids such as normal saline solution; (5) removal of necrotic and diseased tissues, when present.

As before mentioned, these outlines of treatment only apply to ordinary "healthy" wounds. When once the tissues are found unable to cope with the infection, as happens when bacteria such as *B. œdematis maligni*, *B. tetani*, or *B. anthracis* are present, stern antiseptic treatment is essential, though apart from these conditions neither theory nor practice advocate its employment.

The great mortality from tetanus might be prevented were antitetanic serum more widely used, particularly in those wounds which involve muscular tissue and in those of the foot.

THE PRELIMINARY DISINFECTION OF WOUNDS.

The advocates of antiseptic treatment maintain that the first dressing of a wound decides its future course. With limitations and under given conditions, this is doubtlessly true. The limitations comprise the capability of the antiseptic to reach and destroy the invading organisms without producing injurious effects as regards the tissue cells, lymph, and phagocytes. The necessary conditions are that the wound must subsequently be so protected that secondary infection may not occur. Unfortunately, as before explained, there is no antiseptic known at the present time which will overcome these limitations.

A great deal depends upon the nature of the infection. If we have reason to suspect the presence of tetanus bacilli, or if the progress of healing is such as to suggest that the natural resistance is not sufficiently powerful, antiseptic measures are certainly indicated, but an effort should be made to render the wound as nearly aseptic as possible at the first attempt.

Were it possible to thoroughly disinfect the whole cavity and subsequently keep it aseptic, there would be no call for the varied methods of wound treatment at present in vogue.

The Kaffirs have a somewhat novel and extremely successful method which they practise in the treatment of the frequent and often very severe wounds which they receive whilst at underground work in the mines.

Immediately upon infliction, they insert one or more layers of fuse into the depths of the wound, which they then ignite. The burning of these fuses without doubt renders the wound at the time perfectly aseptic. Their next procedure is to drip hot melted wax from their candles into the cavity until it is completely filled and a thick layer of wax covers the surface and the surrounding skin. As the slough is thrown off and the underlying granulations increase, the wax tends to lift; but a fresh layer is applied to the surface daily, so that the wound is kept perfectly air-tight.

The miners relate that under this treatment very severe lacerations heal in a few weeks, which, if treated by ordinary methods, would require several months.

The procedure as nearly as possible fulfils the conditions required, but as no one but a Kaffir would be willing to undergo the treatment, it is not likely to become fashionable in this country.

The technique of wound disinfection varies according to the length of time which has elapsed since its infliction, and the degree of suppuration or necrosis which has become established. The earlier the treatment is adopted, the greater chance there is of securing asepsis.

The first procedure is to thoroughly dress the surrounding skin with a reliable, penetrating antiseptic, and for this purpose a solution of iodine in petrol or the tincture is suitable. Washing of the neighbouring parts is of doubtful value, as a great amount of dirt and numerous bacteria are carried from the skin into the wound cavity by means of the liquid employed.

The wound itself should be carefully examined for pockets which might tend to harbour pus, and the bistoury should be employed to eliminate these, and if necessary to enlarge the wound in a downward direction, if thereby the escape of discharges will be facilitated.

Warm normal saline solution should then be injected with some force from a syringe fitted with a rubber tube. This should be inserted into the depths of the wound, and after all discharges have been washed away the surface should be swabbed with absorbent wool until quite clean and dry. It is perfectly useless to attempt to sterilize a wound which is coated with a layer of pus.

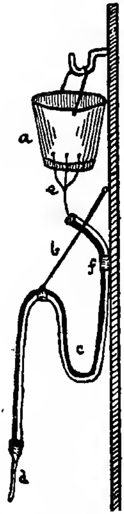


FIG. 7.—SIMPLE APPARATUS FOR CONTINUOUS IRRIGATION OF A WOUND WITH NORMAL SALINE OR ANTISEPTIC SOLUTION.

The fluid contained in the receptacle (*a*) flows through small holes, along a number of cords (*e*). The ends of these are drawn through a length of rubber tubing (*c*), which is securely fastened to the wall or upright at (*f*). The succeeding portion is held in a loop by a strong elastic cord (*b*), so that the tube follows any movement of the patient. The terminal portion carries a length of narrow tubing for attaching to the dressing, as is shown in Fig. 8.

Undoubtedly the most efficient method of applying a liquid antiseptic is by means of a spraying apparatus,* provided with a long nozzle, composed of a material which can be easily sterilized. This should be applied to the depths of the wound and into every recess, particular attention being paid to any part where separation has occurred between the skin and underlying tissues.

---

* Parke Davis's glaseptic nebulizer is very useful. It is fitted with several glass nozzles of convenient shape.

For punctured wounds a teat siphon or an ordinary rubber syringe such as is employed in the treatment of "milk fever" may be used. An extra hole should be made in the extremity of the needle, so that a direct flow can be obtained.

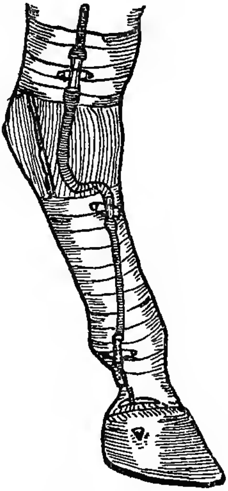


FIG. 8.—METHOD OF AFFIXING TUBE FOR CONTINUOUS IRRIGATION OF A WOUND OF THE CORONET.

It is, however, always advisable to carefully examine punctured wounds and to ascertain their direction and termination before introducing fluids. Superficial wounds may be painted with a soft camel-hair brush, or the antiseptic may be applied on cotton-wool.

We have a considerable choice of an antiseptic. Iodine has for many years held first place among both medical and veterinary practitioners. It may be employed as the tincture or as an aqueous solution dissolved by the addition of pot. iodid., or it may be dissolved in ether and diluted with glycerine. A saturated solution of iodine in petrol may be employed, but when applied to deep cavities is apt to cause a considerable amount of pain, which, however, passes off after a few minutes. It has been recommended in cases of fistula of the withers after the operation of removal of the spinous processes, as it rapidly evaporates and there is no danger of its burrowing between the muscles, as is the case when non-volatile liquids are employed.

Iodine possesses powerful antiseptic properties, and has a very marked power of arresting necrosis. It penetrates deeply into freshly incised tissue, but it has probably no greater power to render pus aseptic or to penetrate it than has any other antiseptic. It is irritant to the tissues, and if applied too frequently or in too great a degree of concentration is liable to produce a moderate degree of sloughing and soreness.

L. Lematte, writing in *La Presse Médicale* of May 13, 1915, described a method of securing antisepsis which has since given good results in veterinary practice. He employs two solutions, which he calls Solution A and Solution B.

Solution A consists of 1,000 parts each of ol. tereb., alcohol, and ether, and 1 part of fuchsin. Solution B contains sod. chlorid., 8 grammes; ol. tereb., 1·5 grammes; boiled water, 1 litre.

His method is to apply a compress soaked in a 12-volume solution of hydrogen peroxide solution and an equal quantity of Solution B for fifteen minutes. The parts are then dried with sterile gauze, and any necrotic tissue is removed with scissors and forceps. The wound is then painted with Solution A and allowed to dry a little, when it is covered with absorbent wool soaked in Solution B and a bandage applied. The parts stain a beautiful red.

The following day suppuration is much diminished, mortified parts assume a red-violet tint, and are removed with scissors. Healthy tissue appears bright red. Cells which are not normal have become pale red.

Solution B is then used to wash the wound, and the pale red parts are again painted with Solution A. After three or four dressings, when the tissues have acquired a healthy aspect, Solution A is discontinued and further dressings of Solution B are applied.

Solution A in Lematte's hands has greatly stimulated cicatrization, and has shown a more pronounced antiseptic action than tinct. iodi. He recommends the use of Solution A in fistulous wounds applied on plugs of gauze. Solution B he considers preferable to boiled water in surgery, as the latter impedes rapid cellular proliferation by its hypertonicity.

Ol. tereb. diluted with a thin oil, such as olive, rape, or sperm oil, in the proportion of 1 to 4 or even equal parts, gives excellent results in the treatment of suppurating wounds, such as sinuses, capped elbows, etc. Ol. caryophyllæ in dilution is equally useful, and has the advantage that it apparently has no retarding influence on phagocyte action; moreover, it has a markedly stimulating effect on the formation of granulations, and has also analgesic properties.

Picric acid has of late years gained some repute as an efficient antiseptic. It is used in a solution of from 0·5 per cent. to 1 per cent. in the treatment of superficial wounds and sinuses.

Drs. T. F. Brown and H. A. Ellis* report uniformly good results—healthy and vigorous granulation and quick recovery. Picric acid is four times more potent than carbolic acid, streptococci and staphylococci being killed in two minutes by a 1 per cent. solution. They found 1 per cent. too strong for new epithelium, and used a 0·5 per cent. to 0·2 per cent. solution when granulation had reached the level of the surrounding epidermis.

---

* See *Lancet*, September 2 and 23, 1916.

After treating 3,000 cases without observing any toxic effects, they came to the following conclusions:

1. It kills bacteria without corroding effect and prevents suppuration.
2. It stimulates granulation.
3. It has marked anodyne properties.
4. It is less irritant and more efficacious than iodine.
5. It may be used for skin sterilization. Staining of the hands may be removed by the application of a solution of sod. bicarb.

A dry dressing composed of equal parts of chloride of lime and boracic acid has lately come into favour, particularly for the purpose of plugging suppurating and necrosing wounds. It is a useful first dressing after operations for quittor and fistulæ. It possesses marked deodorizing properties.

Hypochlorous acid for wound dressing is prepared by mixing chloride of lime and boracic acid in water and allowing the solution to stand for some time. It makes a very useful antiseptic lotion, but is unstable and will not keep for any length of time. Recent wounds which are thus treated usually become free from odour and granulate rapidly. It has also the advantage of cheapness. A preparation which goes by the name of "eusol" consists of two different powders, which, when dissolved in water, produce a solution of "hypochlorous acid."

Carbolic acid is largely used in equine practice, but is unsafe for the smaller animals owing to the danger of absorption. Many coal-tar preparations are on the market, and have similar action, but are only suitable for large animals.

Potassium permanganate may be used in solution, but may also be applied to offensive suppurating wounds or sinuses in crystal form, either on wool or wrapped in thin tissue paper. The results are frequently very good in cases of deep wounds which show swelling and gas-formation, possibly from infection by anaerobic organisms, such as the bacillus of malignant œdema and streptococci.

Some surgeons practise what may be described as "triple disinfection." In this case the wound is successively treated with three different antiseptic fluids, the theory being that all organisms are not destroyed at the same rate by any one fluid, and that certain antiseptics are more potent for aerobes and others for anaerobes.

A preparation which goes by the name of "mastisol" is largely employed on the Continent, but has not so far found favour in this country. It consists of a solution of various resins, and is applied after drying the wounded surface. It quickly evaporates, leaving a coating of resinous material, which, it is claimed, imprisons the bacteria and renders them incapable of doing harm. It is also of assistance in affixing dressings. However this treatment may answer in practice, it is certainly wrong in theory, as only those organisms which are actually on the surface of the tissues can be imprisoned in this manner, whilst those lying deeper in the granulations remain free to carry on their activities, deprived of air and in suitable media for their multiplication.

The facts of the case are that any of the many disinfectants which actually possess marked powers of destroying organisms may be used, with more or less temporary success, provided that the wound is at least of fairly recent origin, contains no necrosing or foreign matter, and that it can be subjected in its entire depth and over its entire surface to the more or less prolonged action of the agent employed.

On the other hand, deep wounds and sinuses which contain necrotic material, have thickened walls, or are lined by a smooth layer of inspissated pus, coagulated blood, or dried lymph, cannot be rendered aseptic by the intermittent or prolonged application of any antiseptic until all necrotic tissue has been got rid of and the linings of the cavities have been destroyed and removed by the use of the curette or caustics.

Curettage, when thoroughly and carefully carried out, is preferable to the application of caustics. The latter remove a more or less deep layer from the walls of the sinus, but have the disadvantage that they lower the vitality of the underlying cells, diminish the protective value of the lymph, and lessen the production of opsonins. This statement applies especially to all the so-called penetrating caustics, particularly to the "caustic alkalies." Silver nitrate produces the best results with the least degree of subsequent injury.

DRESSING DEEP WOUNDS.

This class of wound is usually "plugged," with the object of securing granulation and healing from the depths.

Those which penetrate the thickness of the skin and involve muscular tissue are usually packed with tow, absorbent wool, short lengths of bandage material, or gauze.

Tow is by far the cheapest dressing, but, as sold in packets, is usually very dusty and is by no means aseptic. Before use it should be boiled or well soaked in antiseptics and stored in an air-tight receptacle.

In order to avoid hæmorrhage, deep operation wounds, such as arise from the removal of tumours or after operation for poll-evil or fistulous wither, are usually plugged, the skin being brought together by sutures in order to retain the dressing. The plugs may be left in position for from twenty-four to forty-eight hours, unless swelling and pain become excessive. Should these symptoms be observed, they should be removed, and the wound irrigated with a warm antiseptic solution or thoroughly flushed with saline solution.

In any case in which several layers of muscles are divided transversely, as after removal of the spinous processes for the relief of fistulous withers, fluid dressings are inadvisable, owing to the danger of conveying infective material between the muscles, and as an alternative the parts may be swabbed with dry pledgets of absorbent wool and sprayed with an evaporating lotion such as the Solution A recommended by Lematte, or a solution of iodine in petrol.

Infection by the malignant œdema bacillus is not rare in operation wounds which have been plugged and sutured—in fact, these conditions are very favourable to its growth. Cases of malignant œdema occur somewhat frequently after such simple operations as the removal of shoulder tumours. In one case in which the operation was performed for the removal of a comparatively small growth, under what were at the time considered aseptic conditions, the wound was plugged with boiled tow soaked in 1 per cent. lysol and sutured. After twenty-four hours there was marked swelling and a considerable accumulation of gas in the tissues. The plugs were removed, and the cavity was first cleansed with lysol and free incisions were made into the emphysematous parts to admit air. Hourly irrigation with hydrogen peroxide solution was practised, but death occurred on the fourth day. Malignant œdema is a very fatal complication in horses, and recovery is very rare when once the infection has gained a hold.

We have seen a fatal case occur after operation for fistula of the withers, following plugging with tow soaked in antiseptics and suturing. The animal had been affected with fistula for a considerable period, and possibly malignant œdema bacilli had been present before operation; but as there had been a free admission of air and good drainage, the conditions suitable for their multiplication had been absent.

Against this objection there is, apart from the question of hæmorrhage, one fact in favour of plugging deep operation wounds—namely, that wounds so treated tend to gape, which favours drainage, allows free access of air, and encourages healing from the depths. In addition, it permits of inspection of the deeper portions of the wound, so that any necrotic tissues can be seen or are at any rate rendered more accessible.

After the first few days, when all danger of hæmorrhage has ceased, individual experience will decide whether plugging should be continued or not. There is not the least doubt that unless the material is frequently renewed discharges are retained and keep the surface of the wound constantly in contact with infective material. On the other hand, wounds which are left open, unless of considerably greater diameter at the surface than in the depths, granulate more rapidly in the outer portions than they do in the inner, and by closing too early give rise to unpleasant complications. When the position of the wound allows of a counter-opening being made at a lower point to communicate with the deepest part of the wound, and providing that all necrotic or unhealthy tissue has been removed, the difficulty may be overcome by allowing the original wound to heal from the top or from whatever portion may first unite, and providing for the escape of discharges through the counter-opening by the insertion of a drainage-tube or strips of gauze, and enlarging the orifice, when necessary, by the bistoury. Remarkably rapid healing may be secured by this method in deep wounds of the back and quarters, which under ordinary circumstances heal slowly, owing to the lack of drainage.

When circumstances do not permit of counter-openings, the only alternative lies in the frequent insertion and removal of plugs. These should not be packed in tightly, as pressure applied to the walls of a cavity is opposed to rapid healing. Loose plugs have far greater powers of absorbing discharges. As soon as the wound has closed in its depths, they may be dispensed with altogether, unless drainage is inefficient or the amount of discharge is excessive.

Healing can only occur when the tissues are free to granulate, and when they can exude lymph. The smooth lining which forms in almost all wounds which discharge pus over any length of time imprisons the protective fluids and prevents granulation. To overcome this we must make use of the curette or of caustics, after which the greatest success will follow dressings of sodium citrate solution alternated with slightly alkaline normal saline. Internally, we may administer citric acid, in doses of ½ to 1 ounce daily, in the case of the horse. This treatment hinders coagulation of the lymph and keeps a free current of fluid exudate in constant contact with the wound.

As a dressing for sinuses and deep wounds in general, ol. tereb. suitably diluted with oil has a marked tendency to keep the walls in a healthy granulating condition and free from a deposit of inspissated pus. The old-fashioned "black oil" has a similar action, but is somewhat caustic in action. It is useful as an occasional dressing whenever the tissues appear to be in need of a mild stimulant.

Astringent lotions, such as the well-known white lotion or a lotion of lead and alum, are also useful as occasional dressings in deep wounds, as well as in the more superficial ones.

Ointments are only of service in rare instances. They afford a certain amount of protection to the granulation tissue when it has reached the level of the skin, and thereby encourage the formation of an epithelial covering.

There is no doubt that in the majority of cases healing is retarded by overdressing with antiseptics. Any agent which is sufficiently powerful to destroy micro-organisms is also harmful to living cells. Repeated application of chemicals, if they succeed in penetrating the surrounding discharge, destroy the cells of newly formed granulation tissue and certainly weaken resistance.

It is a matter of common experience that the wounds which receive the most attention (according to the ethics of antiseptic surgery) are usually the slowest to heal.

In a state of Nature healing is usually fairly satisfactory, and when complications do ensue through lack of external intervention at the appropriate time, Nature usually finds a way out of the difficulty. Under conditions of domestication, with surgical assistance, probably wound healing would not suffer greatly had antiseptics never been thought of. Certainly, the results gained by their use do not justify the great faith which has been placed in their use by a confiding public.

Wounds of the lower limbs must be protected from external infection by the application of bandages. These should be applied loosely over several thicknesses of absorbent wool, in order to avoid compression and obstruction to the local circulation.

The bandage should be composed of a material freely permeable by air. A loose stockinet or an ordinary "water-dressing" bandage is suitable. Heavy flannel or "stable" bandages should be avoided. In the case of the smaller animals, or when the wound is not of any great extent in the larger animals also, a triple layer of gauze may be stitched over the wool.

The length of time that a bandage may be left in position depends, of course, upon the nature of the wound and the amount of the discharge, but in the case of operation wounds performed under conditions of asepsis, or, at least, antisepsis, the first dressing may be left in position until the discharge from the wound appears on the outermost layer of the bandage. After the operation of neurectomy and in the case of small wounds of the limbs, nine or ten days is not an excessive period, provided that plenty of absorbent material is employed and that the bandage is only applied just as tightly as is necessary to hold it in position. It is, however, advisable to soak it occasionally in a mild antiseptic solution, in order that the discharges which accumulate in the wool may not become breeding-grounds for bacteria. This difficulty may also be met by the use of antiseptic wool, such as cyanide, boric, or other previously prepared material.

Wounds of the lower abdominal or thoracic regions and the upper parts of the limbs usually require some protection from contamination by litter. In small animals the difficulty may be overcome by applying wide bandages and bedding upon clean straw covered by a waterproof sheet, but in the larger animals a good deal of ingenuity is often required. The most successful method is to attach wide many-tailed bandages to rollers or portions of light harness. Attempts to secure dressings by means of adhesive strips or plasters seldom succeed, as they become displaced when the animal lies, and they also collect particles of bedding, which adhere to them.

In hot weather flies and maggots often cause trouble in unprotected wounds. Ol. picis, creosote, ol. eucalypti, or coal-tar preparations made into an ointment with vaseline and smeared over the surrounding skin, aid in keeping flies at a distance. Ol. caryoph. or ol. eucalypti rubbed down with zinc oxide or boric acid make a very useful dry dressing for use during the summer months.

When once maggots have appeared in a wound, it is a very difficult matter to get rid of them. The coal-tar preparations, though somewhat dangerous in the smaller animals, are the most effectual remedies. Oil of tar, however, does not appear to be nearly so fatal to the parasites.

In the summer of 1916 we had under treatment a spaniel dog. He had suffered from a small wound of the back, which, possibly partly from neglect on the part of the owner and partly from the inborn indolence of the patient, had become infested with maggots. On the first attempt at treatment by the owner, the animal had bolted, and two days elapsed before he was recaptured. In the interval the infestation had become serious. There were then several circular wounds, the size of a shilling, perforating the skin of the back, and from each of these a very large number of maggots could be squeezed out. Close examination revealed the fact that the whole of the dorsal integument was underrun with larvæ, which in places had entered the muscles.

The wounds were dressed with a weak solution of ol. picis in oil without result; the maggots crawled through the dressing without any visible effect. The animal was bathed, all the larvæ which could be squeezed out were removed, and the wounds were then dressed with a coal-tar disinfectant fluid. This had immediate effect. Enormous numbers of maggots left their burrows and were soon destroyed by the disinfectant.

However, from day to day fresh larvæ appeared, and the animal developed complete paraplegia associated with epileptiform convulsions and was destroyed.

The maggots in this case had actually burrowed until they came into contact with the spinal cord in the lumbar region.

THE NUTRITION OF WOUNDS.

Wounded tissues, during their early stages at least, receive an increased blood-supply, which is necessary for the formation of the new granulation tissue. In some cases, however, this natural degree of hyperæmia is not sufficient for the needs of the wound, which becomes weakly and slow to heal.

To overcome this difficulty, there are several means by which an artificial hyperæmia may be established.

Hot fomentations and poultices are probably the two oldest methods of securing local vaso-dilatation with the accompanying increased flow of lymph. Either method is liable to produce œdema of the wound tissues, but this may be avoided by the addition of 1 per cent. of sodium chloride. Poultices are considered bad practice by most present-day surgeons, owing to the fact that the materials used are liable to soil the wound, and that the warmth and moisture present are favourable to the growth of organisms in the poultice material. This can be avoided by frequent renewal and by adding a mild antiseptic such as boric acid to the water used in the preparation. Another method is to apply the poultice after the part has been protected by a layer of cotton-wool and a bandage. This method is particularly applicable to the regions of the coronet and foot.

The addition of a small quantity of sodium citrate to the water used is distinctly advantageous. The actual material employed in preparing the poultice is of no great consequence, providing that it is not septic, is absorbent, and will retain warmth and moisture.

Counter-irritation to the neighbouring skin is often of assistance, especially in those cases where hard fibrous swelling persists. Probably the best application is an ointment composed of equal parts of ung. hydrarg. biniodid. 1 to 8 and ung. iodi 1 to 8, repeated at intervals of from four to seven days.

The application of a tourniquet above the seat of the wound (Bier's treatment) is of great service in wounds of the limbs, provided that inflammatory symptoms are not marked. It should not be applied when pain is very severe.

The rubber cord is applied only moderately tightly, sufficiently to cause pressure on the superficial veins without greatly impeding the flow of blood through the deeper arteries. It may be left in position for twenty minutes to half an hour, and repeated several times a day. The site of application should first be well padded with cotton-wool. Application of the tourniquet above the knee without this precaution may give rise to a mild form of radial paralysis. The ideal appliance for the application of this treatment is an inflatable rubber ring, which when fully distended will impede the flow of blood through the superficial veins without in any way compressing the arteries.

A very bad case of open joint, in which the point of a shaft had entered the fetlock, and in which all treatment failed to bring about recovery, was treated by antiseptic injections and the frequent application of a loosely applied tourniquet. Healing occurred in three weeks after the commencement of this treatment, and lameness disappeared after another month.

Various attempts were made in earlier days to " feed " wounds by the application of albuminous substances such as white of egg. A mixture of egg-albumen and salt is still regarded in some parts of the country as a " specific " in the treatment of poll-evil.

BURNS AND SCALDS.

Injuries of this nature are uncommon among the larger domesticated animals, though dogs and cats are occasionally scalded. Burns from lime and substances of a like nature are sometimes met with.

The first step in treatment should be to exclude air by means of oily dressings such as "carron oil," or by dry protective dressings as flour.

After vesication has occurred the parts should be treated as ordinary wounds.

Should the injury extend to further than the superficial layers of the skin, necrosis usually sets in as a complication.

It is sometimes seen on the backs of dogs, after scalding by the accidental spilling of boiling water. In this position there is a considerable amount of fatty tissue underlying the skin, in which necrotic changes quickly take place. If unchecked, necrosis spreads into neighbouring sound tissues, producing large suppurating gangrenous areas. Treatment then must be directed towards thorough cleansing of the parts and removal of the dead tissues by forceps and scissors. Subsequent application of tinct. iodi, though somewhat painful, usually puts a stop to the necrosis, and healing follows.

CHAPTER IV

THE SURGICAL TREATMENT OF WOUNDS

CONTROL OF HÆMORRHAGE.

WHEN a bloodvessel of small or medium calibre is divided, the severed ends retract into the tissues and the middle and inner coats contract, partially closing the lumen of the vessel. The blood in its passage through this constricted vessel tends to form a clot, which seals the orifice and so arrests the bleeding.

In some instances, however, the vessel may not be completely severed or the incision through its walls may be in a longitudinal direction. In such cases, providing the vessel be only of moderate size, complete division is usually sufficient.

Excessive hæmorrhage may be controlled by several methods: (1) Thermal influence; (2) Action of styptics; (3) Surgical interference.

1. **Thermal Influence.**—The action of heat is sometimes utilized, as instanced by the sealing of the spermatic artery in castration and the searing of the severed stump of the tail in docking. If an iron be used, it should be of a dull red heat. A bright red-hot iron burns away the tissues without sealing the vessels.

Thermo-cauteries have now to a certain extent taken the place of the "irons." The burning of the tissues produces shrinking of the vessels, which are then covered with a carbonized scab which seals their orifices.

Although this and the underlying structures must be rendered sterile by the degree of heat employed, they do not always remain so, and very frequently a mixed infection occurs beneath the scab, which may include such anaerobic organisms as *B. tetani*, which finds therein an ideal ground for its development.

The action of cold is employed in the form of cold irrigations or ice-packs, which have the effect of contracting the orifices of the vessels.

Water at a temperature of 120° F. has an even greater effect in controlling hæmorrhage. Possibly the mechanical friction set up by the application of water plays some part in the process.

2. **Styptics**—(*a*) *Physiological.*—Adrenalin has of late years been largely employed in the prevention and treatment of hæmorrhage. It is, however, of small service when applied directly to the surface of the wound, but requires injecting either deeply into the surrounding tissues or intravenously. It does not appear to be absorbed readily from hypodermic injection, and if administered per os is destroyed by the gastric juice. It has marked vaso-constrictor action, especially upon the small arterioles.

Subcutaneous injection of atropine is also very efficacious in controlling hæmorrhage, particularly in cases of secondary hæmorrhage following castration or other operation.

(*b*) *Chemical.*—Various chemical agents when applied to the surface of a wound arrest minor hæmorrhage by coagulating the blood and constricting the mouths of the vessels. Alum, perchloride of iron, silver nitrate, tannin, and turpentine, are well-known examples.

3. **Surgical** means include such operations as compression, ligation or torsion of the vessel, suturing the skin, and packing with wool or gauze.

Compression may be applied directly to the vessel by means of artery forceps, or indirectly by the tourniquet or by the application of elastic or surgical bandages.

In incised wounds suturing the skin and in deep wounds plugging are usually sufficient.

Ligation is by far the safest method when it can be adopted, but the presence of the silk or other material used is often an objection. Torsion applied by means of artery forceps until the vessel ruptures is quite successful in vessels of moderate size, whilst during an operation it is usually sufficient to compress the severed end in the forceps and to leave these in position until a clot has formed and obliterated the lumen.

Moderate hæmorrhage is beneficial in that it provides an outward flow from the wound and has distinct local cleansing powers.

SUTURES.

In spite of the many objections to suturing, experience shows that the majority of skin wounds heal more rapidly if sutures are inserted and left in position for twenty-four hours. Beyond this length of time they are of doubtful value, excepting in special cases, where protection to underlying structures, such as peritoneum, is afforded by their action in keeping the edges of the skin in apposition.

Sutures limit the amount of air which enters the wound and help to confine discharges and bacteria within it.

Tetanus and malignant œdema bacilli, together with the commoner anaerobes, more frequently affect wounds which have been sutured than those left exposed to the air.

The sutures themselves may become a source of infection even in operation wounds which have been produced under conditions approaching asepsis. The fact that they are constantly saturated with lymph and have a direct connection both with the exterior and interior of the wound provides a means by which various bacteria may gain entrance to its depths. Moreover, the skin itself through which the sutures are inserted is in all probability infected with organisms.

By thus acting as miniature setons, they produce both maceration and infection of the layers of the skin in immediate contact with them, and unless removed in time eventually break through it, producing transverse incisions which materially add to the size of the resulting scar. This is particularly liable to occur if the sutures are too tight. Sufficient space should always be left between the two lips of the wound to allow for subsequent swelling.

There are, of course, various situations in which wounds may occur where contamination by foreign substances such as food, straw, or litter would of necessity take place unless the edges were brought together by means of sutures, and in many of these cases it would be impracticable to adjust any form of bandage or dressing. As examples we may mention wounds of the ventral surface of the body, sternum and thighs, and wounds of the lips and nostrils.

The presence of a covering of hair in the domesticated animals is an additional hindrance to successful suturing. If of any length it must either be removed by scissors, when, as a result, the hairs may contaminate the wound, or it may be left in position, with the possibility of its becoming trapped in the wound and causing infection and irritation. If the hair be short, as in recently clipped horses, it is better left alone. If, however, it be sufficiently long to need removal, the wound should first be packed with wool or gauze, which can be left in position until the parts have been clipped or shaved and the skin cleansed, when any loose hairs will be removed along with it.

The edges of the wound should be interfered with as little as possible, and loose flaps of skin, unless badly bruised or almost completely disconnected, should be left in position. It is unwise to trim the edges of a freshly inflicted wound with the object of obtaining closer apposition.

The number of sutures should be limited, and they should be at least $\frac{3}{4}$ inch apart, excepting in the case of small skin wounds, in operation incisions in the abdominal region, and whenever there is fear of hæmorrhage occurring.

In ordinary cases the insertion of sutures should cease some distance from the lowest point of the wound, in order to allow for drainage.

Silk thread is the suture material most generally used, and as it can be obtained of varying thickness and may be easily sterilized by boiling, it fulfils most of our requirements. It has the disadvantage that it rapidly absorbs discharges.

Paraffined thread is prepared by dipping silk or very fine twine in melted paraffin wax. It should be first dressed with turpentine or tinct. iodi, then dipped in the wax, and finally rubbed through a clean cloth to render it flexible.

Paraffined thread has several advantages. It does not absorb septic discharges, it neither rots nor cuts the skin, and is of especial service for sutures which have to remain in position for a long time.

Catgut and silkworm gut are but seldom used in veterinary practice. The latter is sometimes employed for bowel and tendon sutures, but in small animals silk is preferable. Flexible metallic wire is occasionally used to suture parts which are liable to be subjected to great strain.

Narrow tape is a very useful suture material for large wounds.

Interrupted sutures are the most commonly used. When inserting them it is necessary to carry the needle directly through the skin, as nearly as possible at right angles to its surface, and then through the subcutaneous tissues. Sutures which do not penetrate the skin, but travel through it, almost invariably tear out and retard healing. The knot should be drawn to one side of the incision.

Muscle sutures are inserted as ordinary interrupted sutures, but the ends are left sufficiently long to protrude some distance through the skin wound, and are usually twisted into a cord. They may then be removed without disturbing the external incision, and also assist in draining the deeper parts. Silk is the most useful material for the purpose.

Pin sutures are frequently used in treating wounds of the face, eyelids, nostrils, etc., but have probably no advantage over ordinary interrupted sutures. Button sutures are very useful as " tension " sutures in parts where great strain is involved, such as the buttocks and abdomen. Quill sutures act similarly. One or more " tension " sutures deeply placed may be used to relieve the strain from the ordinary interrupted ones.

Ruptured tendons are united by two rows of interrupted catgut sutures, one row uniting the severed edges and the other being more deeply placed. Excessive strain on the sutures must be avoided by the use of splints.

For bowel sutures Lembert's method, using fine pure silk in an ordinary straight sewing needle, gives the best results.

Metallic clips as used in human surgery have not found favour in veterinary practice, probably because the makers have not supplied an article which fulfils the requirements or satisfies the conditions occurring among thick-skinned patients.

THE USE OF CAUSTICS.

A caustic is an agent which when applied to living tissues causes local cell death. In the majority of cases this action is the result of the combination of the caustic with the albumen of the protoplasm, with the formation of an albuminate.

The various caustic agents differ as regards their power of penetrating the tissues, and consequently in the depth at which they are destructive.

Silver nitrate in pencil form is one of the best in general use. Its action is limited to the area of its application, and does not extend far beneath the surface unless it be kept in contact for some time. In this case it sets up inflammation of the underlying layers, which hastens the casting-off of the slough and favours granulation and rapid healing. Solutions of from 1 to 10 per cent. in distilled water are of great service in treating wounds of the cornea, but have lately given way to some extent to protargol, argyrol, and similar preparations. Mercuric chloride and arsenic are sometimes used for " sloughing " out sinuses, as in the treatment of poll-evil and quittor, but they are liable to become absorbed and set up toxic symptoms. The safest method of applying these agents is in lump form wrapped in tissue paper. The formation of a coating of albuminate around the solid piece prevents absorption.

The actual cautery in the treatment of sinuses, after removal of any apparently necrotic tissue, is without doubt the most efficient caustic, and although crude and more or less barbarous, it is safe and gives excellent results in the hands of a competent surgeon.

Copper sulphate is frequently used to arrest excessive granulation. Its action is similar to that of silver nitrate, but not nearly so severe.

Zinc chloride is a powerful escharotic with great powers of penetration.

A mixture of equal parts of carbolic acid and glycerine is very useful to destroy large masses of " proud flesh." The liquid is painted on to the granulations, a layer of which is immediately blanched and destroyed. This is scraped off and a fresh application is made, and the process repeated until sufficient has been removed. The operation is practically painless, and unaccompanied by hæmorrhage if carefully performed. Equal parts of plumbi acetas and zinci sulphas rubbed together in a mortar until they form a paste make a very powerful caustic for application to sinuses, canker cases, etc. As it has a marked penetrating action, its use should not be too prolonged. The caustic alkalies are very active, but they penetrate deeply into the tissues and are little used. They act by extracting moisture.

Equal parts of ol. tereb. and olive oil applied on plugs has a very marked effect upon granulation tissue. Applied to cavities such as occur in capped elbow, where excessive granulation occurs within the abscess walls, producing considerable swelling, the dressing rapidly brings about reduction and prevents subsequent permanent enlargement.

In slowly healing cavities or sinuses it appears to stimulate the formation of healthy granulations, and should then be diluted down with 4 parts of oil to 1 of turpentine, for subsequent applications.

It is also a very useful dressing for shoulder tumours and fibromata in general. After opening the abscess cavity, if one be present, or after making an incision into the growth, a dressing of equal parts of oil and turpentine is inserted on a plug of cotton-wool and retained in position. The walls of the tumour become destroyed after a varying number of applications, and are replaced by healthy granulation tissue.

Astringents are in reality mild caustics, and are applied to slowly healing wounds to stimulate the formation of granulations. The well-known "white lotion" is an example. This application is frequently applied to superficial wounds and abrasions such as harness injuries, as, apart from its stimulating astringent action, it leaves a deposit, practically a "dry dressing" of lead sulphate, upon the surface of the wound, which affords protection to the granulation tissue and hastens the growth of epithelium. Alum may be used with advantage in many cases in place of zinc. sulph. Alum in powder or in solution acts as a mild caustic and astringent to stimulate weakly granulations. Solution of cupri sulph. or a lotion of 1 part nitric acid and 10 parts spts. vini rect. may be used for the same purpose. The utility of a caustic depends upon its power of destroying tissue, upon the amount of control we can maintain over the depth to which it may penetrate, and the damage it may inflict upon the underlying tissues. In the treatment of wounds silver nitrate and the actual cautery offer most advantages, as they do not exert their influence far below the surface.

Caustics are indicated in all superficial wounds and sinuses which are slow in healing. They should not be employed in the treatment of freshly inflicted wounds, excepting in certain punctured wounds, especially in those caused by snake-bite.

When, as a result of weakening of the resistance by micro-organisms, the healing process has apparently come to a standstill, the application of a suitable caustic destroys the organisms in the outer layer of granulations, where they are most active, and removes the latter as a slough. At the same time the irritation set up causes an increased flow of blood to the part, accompanied by the formation of new healthy granulation tissue. If, however, the caustic penetrates sufficiently deeply to injuriously affect the underlying tissues without actually destroying them, the powers of resistance are lowered and the way is paved for fresh infection.

The majority of antiseptics, when applied too frequently or in a too concentrated solution, exert a slow caustic action, destroy the superficial layers of cells, and weaken the resisting powers of the tissues, so that infection persists in the deeper portions of the granulations and healing is retarded.

In treating long-standing sinuses it is advisable in the first place to use caustics to remove the lining of inspissated lymph and to produce a healthy granulating surface. Necrosed tissue at the bottom of the sinus may also be removed by the sloughing process, providing there be no great quantity present. Diseased bone, however, usually requires surgical removal.

Curettage has a similar effect to that of caustics, in that it removes an infected layer. It can only be used to full advantage in superficial wounds. In deep sinuses it is difficult to thoroughly scrape the entire surface, though it is useful for the purpose of scraping and removing small particles of bone, particularly in the region of the maxillæ. Dorsal spines, when necrotic, usually require the use of the saw or bone forceps for their removal.

Scarification is sometimes made use of to relieve local œdema, and also to freshen the edges of skin wounds which have become dry or covered with epithelium without union having taken place. The two opposed surfaces are first scarified and then brought into apposition by the use of sutures. It is often better to remove a thin layer from the whole length of the edges in place of scarification.

DRAINAGE OF WOUNDS.

The provision of efficient drainage is *essential* to the successful treatment of all wounds.

It should be the first care of the surgeon, and in its absence success is impossible. A large wound freely drained will heal in spite of lack of attendance, provided that necrotic tissues or foreign bodies be not present, whereas a small wound which " pockets " pus will give endless trouble, and usually produces secondary infection or necrosis of neighbouring tissues. Never hesitate to convert a small wound into a large one if by that method alone can free drainage be secured.

Fortunately, in the majority of cases drainage is simply a matter of gravity, and in such the discharges escape naturally and very little interference is necessary. When, however, the situation or shape of the wound prevents this occurring, surgical means must be adopted to provide for a free escape of pus, otherwise " pocketing " will occur.

Wounds of the back, withers, and poll are the worst offenders in this respect. In cases of poll-evil, drainage can only be secured by carrying the incision well forward between the ears, and by making counter-openings at its lowest part on either side. Into these we may insert drainage-tubes, setons, or strips of gauze.

Similar artificial openings may be made in cases of fistulous withers, but care must be taken that infective material does not penetrate beneath the scapula or between the muscles, and it is therefore advisable to select a part of the sinus where there is no great amount of tissue between it and the skin—that is to say, in the most superficial portion of the sinus compatible with efficient drainage.

In foot cases an exit may be afforded to the pus by removing portions of the wall, sole, or frog, and subsequently wrapping in a thick layer of cotton-wool and applying a proper foot bandage. A $\frac{3}{8}$ inch bit such as is used by carpenters, with the screwed end filed off, is a very useful instrument to provide drainage at any portion of the foot, and its use does not necessitate the sacrifice of a quantity of horn, as does the farrier's knife.

Drainage-tubes have never found the favour in veterinary practice that they deserve. Short pieces of fairly stiff rubber tubing, such as is commonly sold for use on acetylene generators, punctured at various points through their length, answer the purpose admirably. It would seem that the chief obstacle to their use is the idea that it is hard to keep them in position. This difficulty can be overcome by transfixing them at either end, when both ends are outside the wound, by an ordinary large safety-pin, which prevents their being accidentally pulled out and yet does not close their ends. Should the wound be too large to permit of this, two straight pieces of wire may be employed, of sufficient length to perforate each extremity of the tube at right angles to each other, or a single piece may be used with the ends turned back and twisted upon themselves. Failing any of these methods, the ends may be affixed by a suture either to a bandage or to the skin itself.

The most common method of securing drainage is by the use of tow, rolled into a loose cord, or strips of gauze inserted into the wound with the ends protruding. Setons are also very frequently used, and if composed of a suitable material, such as strips of gauze or of several strands of cord, they are quite useful. They need frequent renewal, otherwise they become foci of infection. Both plugs and setons are very liable to defeat their own ends by actually blocking the escape of discharges, and in this respect cannot compare for efficacy with properly inserted drainage-tubes in situations where the latter can be made use of.

When a wound ends abruptly, forming a pocket at the lowest extremity, it should either be further incised, so that the line of drainage approaches the skin more gradually, or an opening may be made at the depth of the pocket and a drainage-tube inserted. A large wound with adequate drainage heals much more rapidly than a smaller wound which terminates in a pocket. The more open, the better will be the drainage. It is therefore advisable to plug sinuses and deep granulating cavities at intervals to induce them to gape, which will prevent the retention of discharges and will also admit air to the depths.

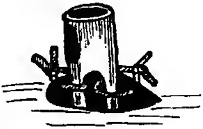


FIG. 9.

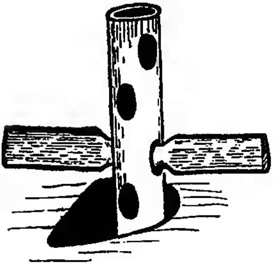


FIG. 10.

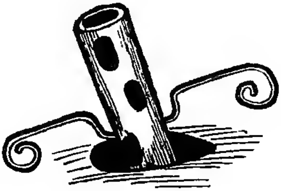


FIG. 11.

FIGS. 9-11.—DIAGRAMS ILLUSTRATING METHODS OF AFFIXING DRAINAGE-TUBES.

(1) By suture; (2) by means of a wooden peg; (3) by means of a bent piece of wire.

Deep wounds of the upper parts of the body, when counter-openings are out of the question, can be drained by plugging them with absorbent material and changing the dressings at frequent intervals, or as soon as they become saturated with discharge.

Another means of keeping a deep wound free from discharges is by the method of continuous irrigation. An apparatus suitable for its employment is shown in Figs. 10 and 11. If desired the cords or tapes may be caused to drip into a funnel suspended a few inches beneath their extremity, when the rate of flow can be plainly observed. This system is very serviceable in the treatment of deep sinuses or wounds of the upper part of the body. Normal saline solution may be employed with or without the addition of a mild antiseptic, as boric acid or pot. permang. The rate of flow should be regulated so that 2 gallons of fluid will provide irrigation for about eight hours.

CHAPTER V

SOME COMPLICATIONS AND SEQUELÆ OF WOUNDS

INFECTION must be considered a normal complication of natural healing, although certain types of organisms may give rise to symptoms which are not in accordance with those associated with healthy processes.

Tetanus, malignant œdema, septicæmia, and toxæmia, may all bring about a fatal termination, but the former of these may at any rate be prevented by the use of antitetanic serum. Cases of local tetanus—that is to say, tetanic symptoms affecting the muscles in the immediate vicinity of the infected wound—have been described by some authors after the use of serum, and must be ascribed to insufficient dosage.

One American observer has stated that local tetanus may be observed in many cases in which the serum has not been used, several days before the onset of general tetanus, but no similar observations have been made in this country.

Antitetanic serum can only be relied upon to afford immunity for from eight to ten days, so that a weekly injection is advisable for absolute security, although experience shows that the early stages—for example, the first ten days—is the most favourable time for infection, so that, allowing for the somewhat lengthy incubation period of the disease, tetanus is more common between the first and third weeks than later. It is very rarely seen as a complication of chronic sinuses which discharge a considerable quantity of pus, as in poll-evil or fistulous wither.

Adhesions between the scar and important underlying structures may result. After the operation of neurectomy, particularly after section of the plantar nerves, the cut end of one or both may become adherent to the connective tissue of the scar. The subsequent contraction causes pressure on the nerve fibres, attended by pain and lameness, and the formation of a neuroma. Resection of the affected nerve at a higher point is preferable to removal of the growth. When operating, care should be taken to divide the nerve as far as possible above the upper extremity of the wound, which is facilitated by flexing the limb at the fetlock joint. There is less danger of neuroma-formation if the wounds are left open and unsutured. Healing is more protracted and occasionally excessive granulations form, but there is greater opportunity for "accommodation" of the underlying structures, and a more successful operation is the result.

When laparotomy wounds heal, the omentum and portions of the viscera usually become adherent to the parietal peritoneum at the seat of the incision, often without causing any inconvenience. In some cases, however, chronic peritonitis ensues. Upon one occasion in which ovariotomy was practised upon a very young terrier puppy, complete asepsis was not maintained owing to interruption caused by the repeated vomiting and temporary collapse of the patient under the influence of the anæsthetic. The wound healed and the case apparently progressed favourably for a few weeks. After a month the animal developed symptoms of peritonitis, with vomiting and prostration. These symptoms disappeared, only to be repeated at intervals of one or two months until the patient was twelve months old. At this time destruction was decided upon.

On post-mortem examination the omentum and portions of intestine were found to be adherent to the parietal peritoneum at the site of the incision, and marked congestion of the visceral peritoneum was evident. There was no sign of pus or increase in the abdominal fluid.

On another occasion we made a post-mortem examination of the body of an aged terrier bitch which we had operated upon some time previously for the removal of several large cystic calculi from a septic bladder.

Death had resulted in this case from chronic purulent metritis and toxæmia.

The incision, which had been made in the superior surface of the bladder in order to remove the calculi, was scarcely recognizable, being represented by a minute cicatrix hardly larger than a pin's head. The floor of the bladder, however, was united firmly to the parietal peritoneum at the site of the operation wound by fibrous adhesions. No difficulty in passing urine had been observed at any time subsequently to the operation, and apparently no ill effects had resulted.

Lymphangitis is a common complication of septic wounds, particularly of those affecting the feet, limbs, and back. Saddle-galls are frequently associated with marked cording of the neighbouring lymphatics. Lymphangitis arises from the passage of irritants, either chemical, bacterial, or both, through the lymphatic vessels, until they are arrested by the lymph glands, which are, of course, the barrier to septic invasion of the blood. Septic lymphangitis frequently follows nail-pricks, and is at all times very serious and frequently fatal.

It usually commences with marked swelling of the limb, fever, and lameness. Frequently there is a visible wound either in the foot or on the fetlock or other part of the limb. In a few days an abscess will develop, possibly in a part of the limb remote from the original injury, or even in the inguinal or axillary lymphatic glands. In some cases, particularly when infection enters via the foot, a number of small abscesses will form on the course of a lymphatic, the early ones appearing just above the coronet, and the later ones progressively higher on the canon and then on the inside of the thigh. Prognosis must always be guarded in such cases, and recovery depends upon the virulence of the infection and the capability of the glands to bar the passage of the infection.

We may attempt vigorous antiseptic treatment of the wound, and open abscesses at the earliest possible moment. An autogenous vaccine may be of use in such a case, providing that the animal does not become too badly affected during the time that is required for its preparation. A reliable stock vaccine may be given at the commencement of the disease.

Internal treatment should be directed towards securing elimination through the available channels and reducing fever, should this become dangerous. Hæmatinics and tonics such as iron and arsenic or iodides, preferably in the form of Donovan's solution, are indicated.

Cellulitis occurs to a greater or lesser extent in the majority of wounds, and is seldom of any consequence, providing that the tissues retain their powers of resistance. Hot fomentations are the best means of combating the condition, together with gentle exercise, when permissible. A form known as "ulcerative cellulitis" is common among horses of the Expeditionary Forces, and has also been observed among horses in hospitals at home. It is ushered in by fever, very severe lameness, and great swelling of the limb. An abscess then develops on the cannon of either limb or on the hock. At intervals of a few days other abscesses develop, usually below the seat of the last one (contrary to that observed in lymphangitis), until the cannon or hock appears almost as though it had been point-fired. The condition is very tedious, and if recovery does eventually occur, it is frequently after several months' treatment. Recent investigation has proved that ulcerative cellulitis is identical with the ulcerous lymphangitis of Nocard, and that the causative organism is the Priesz-Nocard Bacillus. The varied types of lesions are due to variation in the method of infection and difference in the virulence of the toxin. The condition is not attended by suppuration within the lymphatic glands, though a mild degree of swelling and induration may be present. In both epizootic lymphangitis and cutaneous glanders the lymph-glands become extensively involved.

Œdema may result from local vascular changes or from infection by various organisms. The former may be distinguished from the latter by the absence of heat and pain, the non-formation of gas, and in the majority of cases by the absence of fever. Marked œdema of the sheath and lower parts of the abdomen usually follows operations in the region of the scrotum or wounds of the abdominal region. It is best relieved by exercise and by providing free drainage from the wound.

Phlebitis and Thrombosis.—Thrombi may occur in veins some distance from the actual wound, as the result of bruising and damage to the endothelium occurring at the time of injury. It must also be remembered that a large number of vessels of varying but mostly of small calibre are severed in almost every wound, and, owing to their free ends being plugged by coagula, infection is very likely to extend to them. The breaking down of these coagula by bacterial action is the cause of cases of secondary hæmorrhage occurring days or weeks after the infliction of the wound.

When a thrombus breaks down in a vein, there is danger of embolism occurring in some of the branches of the pulmonary arteries. There is small possibility of arrest of the particle until it has passed the right ventricle, owing to the comparatively large size of the vessels traversed; but immediately it reaches the fine arterioles of the lung it becomes arrested and gives rise to an embolism, terminating in abscess-formation associated with gangrenous pneumonia.

Toxæmia, Pyæmia, and Septicæmia.—Either bacteria or their products may under certain circumstances enter the blood-stream from an infected wound via the lymphatic system in those cases in which the glands are unable to cope with the invasion. Some toxins, notably tetanus toxin, particularly attach themselves to nerve tissue.

Punctured wounds of the foot and cases of septic coronitis are very liable to be followed by one or all of these conditions or by embolo-phlebitis, terminating in gangrenous pneumonia. Pyæmic abscesses may occur in the lung, as large abscesses few in number, or as multiple abscesses ranging in size from a pin's head to that of a hazel-nut. Pyæmic abscesses may, however, develop in any part of the body.

Hard fibrous swelling sometimes persists in cases of poll-evil and fistulous wither and in large flap wounds after healing has been completed. In such instances the repeated application of absorbent blisters and the intramuscular or local injection of thiosinamin preparation often effects reduction.

CHAPTER VI

WOUNDS OF THE HEAD AND NECK

WOUNDS OF THE FACIAL REGION.

THE most common situations of facial wounds are the eyelids, alæ of the nostrils, and the area overlying the nasal bones, though injuries frequently occur in other parts of the face.

Wounds of the Eyelids.

These may occur from contact with nails in walls, racks, or mangers, with the point of the shaft whilst turning the head, from blows inflicted accidentally or maliciously, or from falls, etc.

The wound may be incised or lacerated. The injured portions hang down and rapidly become swollen and tumefied, the edges dry up under a scab of coagulated blood and lymph, and if surgical means are not taken to secure early union, healing is delayed and is seldom complete, some degree of deformity usually remaining.

If a good many hours have elapsed between the infliction and the examination of the wound, it will be necessary to either scrape and scarify or to trim the edges before commencing to insert sutures. These should be interrupted and of fine silk, and a very small human pattern needle should be employed, as a large puncture made with a coarse needle facilitates the tear-in of the suture material through the tender eyelid.

The sutures should be shallow and inserted close together, so as to ensure a good hold, otherwise the torn portion will become disconnected before healing is complete. If sutures be inserted sufficiently deeply (so as to completely pierce the whole thickness of the skin) they will come into contact with the conjunctiva, and irritation will ensue, with lachrymation and possibly keratitis as a sequel. Cocaine in 5 per cent. solution, poured on to the eyeball and injected at one or two points through a very fine needle, considerably simplifies the operation. We have found Parke Davis's dental syringe very convenient for the purpose of inducing local anæsthesia with cocaine. It frequently happens that after healing has ceased a small protrusion representing the extremity of the torn portion remains unattached and extends beyond the margin of healing. An attempt should be made to secure union by trimming the opposed edges and inserting a suture. If this method fail, as it possibly will do, the portion may be removed by an oblique cut made with a pair of curved scissors, which will considerably lessen the degree of deformity.

To avoid inflammatory changes occurring in the eyeball from local irritation, a little weak ung. hydrarg. oxid. flav. may be applied daily to the cornea. The wound should be dressed with warm normal saline solution several times daily, and every precaution should be taken to prevent the animal rubbing the part. Pillar reins by day and a loose box at night are usually sufficient, but may be supplemented by the use of a flap of flannel saturated with saline solution, suspended from the headpiece of the night halter. Healing usually occupies from ten days to a fortnight. It is advisable to remove the stitches gradually.

Wounds involving the supra-orbital pad of fat are often very troublesome, as suppuration occurs, and it is not possible to provide drainage. Great swelling and œdema of the eyelids results, with the exudation of a large quantity of lymph, which coagulates upon the surface of the cheek. Frequent cleansing of the wound and conjunctiva with warm solution of sod. hyposulph. gives good results. When the eyeball itself is undamaged, recovery is the rule.

Wounds of the Eye.

The following are the most common complications of wounds of the eyeball: Conjunctivitis, corneal ulcer, escape of aqueous humour, staphyloma, prolapse of the iris and of the lens, suppuration or hæmorrhage into the anterior chamber, damage to the retina, complete loss of the eyeball.

This list does not include atonic ulcers, which are merely the result of local malnutrition, and are very common in Pekingese, pugs, and toy Pomeranian dogs. Wounds which do not penetrate the cornea may be treated with lotions of boric acid or zinc. sulph., grs. ii. to ℥i. water. The addition of a small percentage of cocaine or quinine and urea hydrochloride is advantageous.

Should conjunctivitis persist, with marked opacity, a lotion of argenti nit., grs. i. to x. to ℥i. aqua distill., or a 1 per cent. ointment of hydrarg. oxid. flav., may be employed.

Powdered calomel dusted on to the cornea is of use as a stimulant, but should not be applied too frequently. It may with advantage be alternated with finely powdered zinc. oxid.

Escape of the aqueous humour follows puncture of the cornea. As this fluid is simply a solution of sodium chloride, warm normal saline presents the best cleansing agent for wounds of this description. With the object of closing the puncture, we may carefully apply pure silver nitrate to the edges.

The colloid silver preparations are useful in these cases, but in our opinion have no advantages over ordinary lunar caustic and its solution. Should the corneal wound be large, time is the only healer. It is unwise to apply dressings, which will then enter the anterior chamber and set up irritation.

Prolapse of the iris may sometimes be reduced by subjecting the eye to the action of strong light, which causes the muscular tissue to contract, or by closing the lid and gently massaging the surface of the eye. The application of eserin may be successful.

Hypopyon—pus in the anterior chamber—is treated by squeezing it out through the wound, and subsequently irrigating with warm normal saline solution containing a little boric acid. Should the wound have closed, puncture of the cornea at its lowest point is necessary.

The white scar tissue remaining after wounds of the eyeball have healed can be reduced in amount by application of silver nitrate solution. Internal administration of pot. iodid. and intramuscular injection of thiosinamine solutions may assist.

Wounds of the False Nostril and Alæ.

These may arise from similar causes to those last described. They are usually lacerated, as they are often occasioned by the animal jerking the head after some protruding nail or other fixed object has entered the false nostril.

It is usually a very difficult matter to secure complete union in extensive wounds of this region, partly owing to the fact that the parts become soiled during feeding and by the nasal discharge, and partly because the animal takes every opportunity to rub the nose against neighbouring objects. Healing, however, usually occurs sooner or later, but a certain degree of deformity commonly persists.

Owing to the thickness of the alæ of the nostril in horses, when cut completely through it is advisable to first insert sutures from within the false nostril into the internal edges as far as can be reached before suturing the external skin. This, however, can only be accomplished when the wound is situated close to the nostril.

Treatment must be confined to suturing and the adoption of any means possible to avoid contamination by food and to prevent rubbing.

It will often be found necessary to insert sutures on many separate occasions in order to maintain the edges in position. Nevertheless, it is really surprising how well wounds of this class often heal after a long treatment, and after one has begun to despair of success.

Wounds of the Face.

These are seldom serious unless they involve large vessels or nerves or injury to the salivary ducts. They are usually united by pin sutures, and healing is usually rapid and complete.

In some cases, however, owing to neglect, healing may be imperfect. In the region of the forelock, particularly among pit ponies, large V-shaped flaps of skin may be displaced, owing to the animal striking the poll. From constant movement, either healing does not occur or is incomplete, and deformity results. If sutured soon after the occurrence of the injury, little difficulty is usually experienced, provided that the head be tied high, so as to limit movement, either to the rack or some other fixed object. If this be unsuccessful the flap should be excised.

Similar disfigurement may follow flap wounds of the skin covering the nasal bones, and is produced by the animal rubbing the parts against the manger.

In dogs we have observed spontaneous gangrene of the cheek, and similar cases have been recorded in cattle. A small papule appears at the commissure of the lips, and in a few hours develops into an ulcer. The affected area then becomes necrotic, and in a few days the condition spreads until the cheek is practically destroyed and the molar teeth are visible. The surface of the gangrenous area is greyish and shred-like, and the odour is almost unbearable. The animal salivates and is unable to feed, although it may appear desirous of doing so. Temperature is raised, rigors are usually very marked, and the appearance presented is one of great depression. Sometimes both cheeks are affected simultaneously. The cause is uncertain. Many types of organisms are present in the lesions, especially spirillæ from the oral cavity. Treatment in advanced cases appears useless, and antiseptic measures do not control the course of the disease. In the early stages, as soon as diagnosed, the patch of skin should be excised, operating in sound tissue and subsequently painted with iodine. Healing will then occur with little or no deformity.

Wounds of the Tongue.

These may arise from misuse of the bit, from bites inflicted by the animal's own teeth, particularly during falls, and from rough handling or pulling the tongue forcibly out of the mouth, as in balling and operations on the teeth. In this case the frænum may be ruptured.

Occasionally, whilst grazing, the tongue may become snared with string or wire, and extensive injury results. Provided that the injury is confined to the tongue, and that no damage has been inflicted upon the inferior maxilla, healing usually takes place without complication. When the bone of the jaw has been exposed, the parts at once become infected by the numerous organisms which are constantly present in the mouth, and a putrid, fœtid wound persists.

The treatment of wounds of the tongue must be directed to the provision of soft food and the cleansing of the mouth after each meal. Horses should be watered after, instead of before, feeding. Alum and pot. permang. in solution may be applied, as a lotion, on a swab of cotton-wool or sponge attached to a stick or held in a pair of long-handled forceps. Electuaries of pot. chlor., alum and borax, are useful, as is also sod. hyposulphite, either in electuary or lotion.

Wounds of the inferior maxilla within the oral cavity and of the interdental space should be curetted and painted with tinct. iodi or touched with silver nitrate. If sufficiently deep, plugs should be inserted to prevent the entrance of food materials.

Injuries to the interdental space produced by pressure of the bit, or those of the lower maxilla arising from pressure of the curb chain, may give rise to periostitis, osteomyelitis, and sinus-formation. The latter usually discharges upon the lower border of the ramus from several small openings. There may be slight or considerable enlargement of the bone. In long-standing cases excision of the portion of skin containing the fistulous openings and trephining of the enlarged bone is usually necessary.

This will often be found to be honeycombed with sinuses, which contain pus and portions of necrotic bone.

Recent cases often yield to antiseptic treatment, or in some instances the insertion of a red-hot knitting-needle into each opening may be beneficial. Blistering sometimes gives satisfactory results. This condition must not be confused with dental fistula, which it resembles.

Dental Fistula occurs as a sequel to alveolar periostitis, from extension of infection and pus-formation to the

PLATE I.

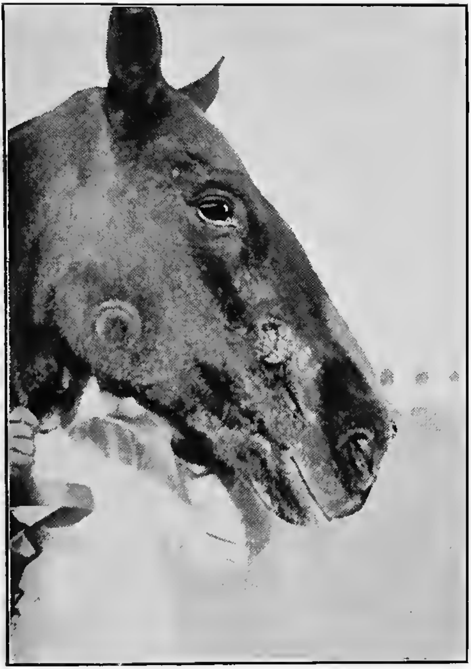


Fig. 12.—Dental fistula.

To face page 74.

bone tissue itself. In the upper jaw it is usually associated with pus-formation in the superior maxillary sinus, into which the roots of the upper molars extend, and nasal gleet, although the latter condition is by no means constant. In the lower jaw the fistula opens either on the lower edge or internal aspect of the ramus, seldom on the external.

Treatment necessitates removal of the offending tooth, although this is not always an easy matter, as the crown is frequently affected with caries and affords no hold for the forceps. Frequently, in the upper jaw, a sinus passes through the crown of the tooth and extends into the superior maxillary sinus, nostril, or on to the skin. Through this food passes whilst mastication is in progress. Failing extraction, an attempt may be made to check the passage of food by depressing the bone over the alveolus with a square-pointed punch and hammer, through an incision made behind the zygomatic ridge. This is not always successful; the bone should not be broken, but sufficiently depressed and damaged to produce granulation tissue, which will help to close the sinus.

Sometimes the tooth may be punched out after trephining the maxillary sinus, though this method cannot easily be put into practice in the case of the lower jaw, for fear of fracture. If the fistula be first enlarged with a small trephine the danger is lessened.

After removal of the tooth the fistula usually closes. An application of biniodide of mercury ointment hastens a favourable result.

In cases of fistula of the lower jaw where the fangs of the tooth are greatly enlarged and extraction is impossible, injection of lactic acid solution has been recommended. Possibly an arsenical preparation might be employed to plug the cavity, followed after some days by soft gutta-percha, in those cases in which there is a free passage for pus to enter the mouth. If, however, the fistula presents the only exit to pus from the alveolus, this method would be impracticable in many cases.

Salivary Fistula.

Fistula of one or other of the salivary ducts may occur as a result of external injury. On some occasions the discharge of saliva may issue from the parotid or sublingual glands themselves. The commonest situations of fistulæ of the duct are the lower border of the ramus or the cheek. A parotid gland fistula may open in the neighbourhood of the gland itself, but very frequently it occurs in the intermaxillary space, and is liable then to be diagnosed incorrectly. On some occasions the saliva enters a large septic pocket in the region of the internal pterygoid muscle, whence it travels down a narrow sinus, to eventually escape, mixed with pus, on the inner surface of the maxilla. The abscess cavity formed in the pterygoid region may communicate with the guttural pouch of that side.

In fistula of Stenson's duct it is usually very difficult to obtain healing, as frequently the portion between the fistula and the mouth becomes occluded and the lining of the duct tends to unite with the skin wound. Constant trickling of saliva also weakens the granulations.

Treatment.—Many cases of fistula of the gland itself heal within a few days of the injury, but in chronic cases treatment is difficult. If ordinary suturing, the application of silver nitrate, or blistering, fails, an attempt may be made to destroy the secretory activities of the gland tissue by injecting ethyl alcohol or 20 per cent. lactic acid solution through the fistula. When the opening is on the inside of the maxilla and mastication is interfered with, pterygoid abscess must be suspected, and the sinus should be carefully enlarged to provide drainage for pus. If healing does not occur, the duct may be exposed as it crosses the lower jaw, and alcohol may be injected through it into the gland substance, after first plugging the enlarged fistula. These operations can only be properly performed whilst the animal is under the influence of a general anæsthetic.

In fistula of the duct a means must be found of allowing the saliva to enter the mouth. Stockfleth recommended exposing the duct behind the fistula, piercing the cheek in an oblique direction, and inserting the free portion of the salivary duct into the opening, and keeping it in position until union occurred by a suture.

Lefosse and Hering passed a tape through the opening of the fistula, through the cheek, and into the mouth by means of a trochar, and tied the two ends at the commissure of the lips. After an artificial opening had been produced by leaving the seton in position for some time, they closed the external orifice by a purse-string suture, when in successful cases healing occurred and the saliva found its way into the mouth.

If all the above-mentioned methods fail, an attempt may be made to destroy the gland, by ligaturing the duct at a point between the gland and the fistula. This operation is succeeded by a great deal of swelling, but in many cases has proved successful.

Pre-auricular Fistula ; Dentigerous Cyst.

This condition is characterized in horses by the presence of a small fistula at the base of and slightly to the front of the auricular cartilage. It is dependent upon the presence of a tooth in an early or advanced state of development, in a position corresponding to one of the embryonic branchial arches (see Fig. 20).

Treatment consists in cutting down on to the tooth and removing it if possible. In some instances it is firmly embedded in one of the cranial bones, and its extraction may be difficult or even dangerous. In such cases it is as well to leave it in position. It is very rarely that a dentigerous cyst gives rise to any serious symptoms, and it need not interfere with the animal's working capability.

WOUNDS OF THE CERVICAL REGION.

These may be serious or of no great consequence according to their position.

Wounds of the tracheal region may involve the trachea itself, the œsophagus, jugular vein, carotid artery, and the important branches of the nervous system which accompany these vessels. Wounds involving the trachea are not common apart from those produced during the operation of tracheotomy. Their chief danger is hæmorrhage into the air passages, which may cause death either at once from asphyxia or at a later date from septic pneumonia. Wounds of this class are usually attended during healing by the production of an excessive amount of granulation tissue, which in some cases causes an obstruction in the trachea. As this tends to persist after healing is complete, and causes difficulty of breathing and stertor, operation is often called for. The trachea must be opened in the middle line immediately below the scar, and the granulations removed by the scalpel or ecraseur, whilst being held in hooked forceps. An inflatable tampon cannula is of great service in this and in other operations upon the trachea and larynx. Failing this, an ordinary tracheotomy-tube may be inserted below the site of operation, and the lumen of the trachea may be occluded above the tube by the insertion of a sponge attached to a cord, by which it may be withdrawn after the operation has been completed.

Wounds of the large bloodvessels of the neck are always serious, particularly as skilled assistance is seldom available at the time. Puncture of the jugular vein is indicated by a steady flow of dark venous blood, whilst a rapid, jerky outpouring of arterial blood suggests damage to the carotid artery. Bleeding from the latter vessel may, however, be quite steady and free from jerkiness if the external wound be small, as the artery is more deeply placed and the blood may flow into the subcutaneous connective tissue before issuing from the incision. Hæmorrhage from the jugular vein associated with a small incised wound of the skin can usually be arrested by suturing the latter. Phlebitis may follow, but cannot be avoided, as infection may have occurred at the time of injury. Air may also enter the blood-stream and cause death, but such occurrences are not common unless the vein be completely severed.

If the external wound be large or lacerated so that suturing will not control the hæmorrhage, ligation of the vein is essential. Two silk cords should be applied an inch or more apart, according to the extent of the injury, and the intervening portion of vein removed.

All cases of carotid bleeding must be treated in the same way, after first separating the vessel from the vagus, sympathetic, and recurrent nerves. Should these be also severed, paralysis of the corresponding side of the larynx results, with " roaring," though if merely divided recovery may occur.

Œsophageal wounds are best left to Nature to heal. Suturing of the œsophagus is seldom successful. In dogs, liquid food such as milk and soups should only be allowed. In the larger animals hay, followed by water, is the best diet. Mashes and short food must be avoided. Healing usually occurs after several weeks, but in some cases a fistula persists. To avoid this the external wound should be frequently enlarged, and the edges of the œsophageal orifice lightly touched with silver nitrate.

Wounds of the skin of the neck very frequently require a long time to heal, and often a certain amount of deformity persists, owing to the edges puckering or turning in. This is especially common in wounds the direction of which is transverse to the long axis of the neck. Before suturing a wound of this type an elliptical piece of skin should be removed an inch away from either side of the incision, at about its centre. The pull exerted upon the edges of the latter by the contraction of the small wounds is usually sufficient to avoid turning in of the edges.

If this condition be already present when attention is directed to the case, it will be necessary to dissect the edges free, to separate them for some distance from the underlying fascia, trim them with scissors, and suture very closely with silk, preferably with one or two button sutures, more deeply placed, to act as a support. It is sometimes advisable to remove a portion of the exposed fascia, but this should not be done if it can be avoided, owing to the risk of infection extending to other parts. In some cases it is necessary to incise the skin at either side of the primary incision, an inch away from it and in length to correspond, in order that the edges may be brought into apposition for the application of sutures (see Figs. 2 and 3, p. 28).

In some cases it is well to insert one or two pairs of sutures an inch or so from the edges of the wound, and to insert tapes through these which may be tightened or relaxed at will, in order to take the strain off the opposed edges. If desired, these may be lifted and the sutures inserted after bringing the deep surfaces of the skin into contact. This gives a much firmer hold, and no fear need be entertained as to the ultimate union of the edges, which occurs in the same manner as if the ordinary method were adopted (see Fig. 5, p. 28).

This refers particularly to old wounds which have incompletely healed.

Wounds of the lower end of the neck such as are produced by running into sharp objects may penetrate the chest by passing under the scapula and through an intercostal space, or by the object entering between the first two ribs. In any case, accidental thoracic punctures are very serious (see Penetrating Wounds of the Thorax).

Injuries to the subscapular tissues usually result in extensive suppuration and abscess-formation, either behind the neck of the scapula or in the armpit. In either case the provision of adequate drainage, insertion of tubes, and ample flushing with normal saline solution, usually brings about recovery after a varying period, which may verge into months.

CHAPTER VII

WOUNDS OF THE TRUNK

PERFORATING WOUNDS OF THE THORAX.

Wounds of this type usually result from collision with the pointed shafts of vehicles, from impact of bullock's horns, and frequently in cattle they arise from the passage of sharp foreign bodies out of the reticulum which penetrate the diaphragm. The most common seat in horses of thoracic wounds resulting from violence is the front of the chest between the first two ribs.

The complications which may arise from penetrating wounds of the thorax are hæmothorax, pneumothorax, and pleurisy. In some cases the thoracic viscera may be damaged or portions of lung may prolapse. Emphysema is usually associated with injury and perforation of the lung tissue. Prognosis is in all cases grave.

Hæmothorax occurs in most cases in a greater or lesser degree, and the coagulated blood, after becoming infected by the penetrating body or through the agency of the air, forms a very suitable medium for bacterial growth.

Pneumothorax is of greater importance in horses than in cattle, as the mediastinum is normally perforated in the former, and hence not only does infection rapidly spread to the opposite pleural sac, but the danger of collapse of the lungs is thereby greatly increased. Pneumothorax is, however, but seldom a fatal complication *per se*, providing that there is a free passage to the entrance and exit of air. Occasionally a flap of skin, muscle, or pleura, acts as a valve, allowing ingress of air but not egress, and results in a ballooned condition of the thorax, with collapse of the lungs.

Pleurisy is the most serious complication, and, as it is of a septic nature, usually terminates in death.

Treatment is seldom of any great value when once pleurisy has become established.

The wound should be cleansed with dry wool, painted with tinct. iodi, and closed as soon as possible after its infliction. No attempt should be made to inject fluids. If hæmorrhage should be at all severe, an effort should be made to check it by means of forceps or ligatures, but plugging the wound should be avoided, as there is a danger of damming the blood back so that it flows into the thorax. Many thoracic wounds are so situated that gravity alone prevents this occurring; and if this be the case, it is as well not to interfere unless the degree of hæmorrhage be very excessive.

Loosened portions of fractured ribs should be carefully palpated, and if they appear detached and it seems possible to remove them, the operation should be performed. If, however, there appears to be a reasonable prospect of union and the free ends do not penetrate the pleura, it will be better to leave matters as they stand.

Pneumothorax must be treated by removing any valve-like flaps and by suturing in the case of small wounds. Flexible collodion may be applied over the sutures. In large wounds, in which there is loss of tissue and when the edges cannot be brought together, the cavity may be closed by oiled silk and a wide bandage. It will be necessary to remove this at intervals to allow of dressing and drainage.

When pleurisy supervenes, as it does in most cases, the original wound should not be disturbed, unless it be situated in the lower part of the chest wall, when the exudate, which is usually very copious in septic pleurisy, may be drained through it. If it be situated high up, paracentesis should be practised, with a trochar of fairly large bore through which the clots of fibrin can pass. The puncture should be made as low as possible, and should penetrate any of the intercostal spaces between the fifth and eighth ribs in horses and dogs or the sixth and eighth in cattle. The trochar should be inserted as near to the anterior edge of the posterior rib as possible, in order to avoid the intercostal vessels.

After removal of the exudate, the pleural cavity may be washed out with warm normal saline solution, prepared with boiled water, which should be injected through the cannula and withdrawn by the same means.

Medicinal treatment and other measures should be practised simultaneously. In ordinary idiopathic pleurisy some observers recommend the hypodermic injection of freshly drawn pleural exudate. In cases of septic pleurisy we have attempted the injection of a small quantity of exudate which has been subjected to a temperature of 120° F. for four hours and filtered, but have observed no beneficial result. The progress of septic pleurisy is so rapid and systemic effects are so marked that nothing short of energetic surgical treatment is likely to be of service, and this is only successful in a very small percentage of cases.

WOUNDS OF THE THORACIC REGION WITHOUT PERFORATION.

Small wounds of the chest wall usually heal under ordinary treatment. Hæmorrhage from the "spur vein" is not uncommonly met with, but is not difficult

PLATE II.

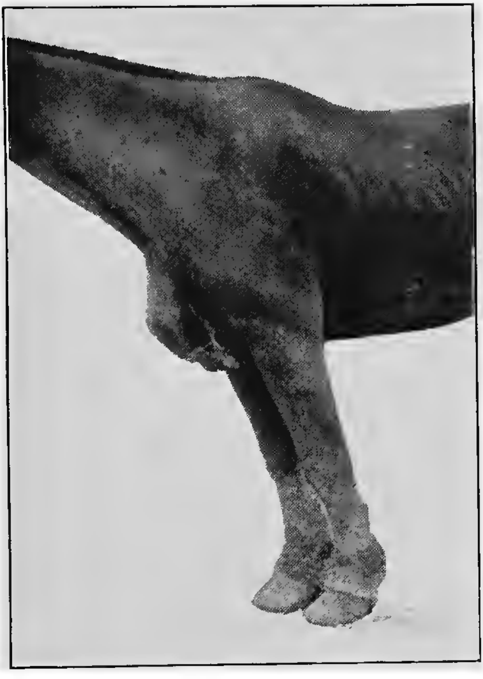


FIG. 13.—Fistula of the sternum.

To face page 84.

to deal with. The axillary region among horses is sometimes the seat of extensive injury, resulting from the animal falling upon a sharp object, as the stump of a tree. Mere abduction of the limb in the act of falling has been proved, in heavy horses, capable of rupturing the skin and pectoral muscles in the axillary region.

In severe cases the scapula may appear to be almost completely severed from the trunk. Hæmorrhage is always severe, and if the axillary vessels are divided proves fatal. Such, however, is seldom the case. Treatment consists in slinging the animal and frequently irrigating the cavity with normal saline solution or Lamette's Solution B. Suturing must, of course, be avoided—in fact, the chief difficulty is to prevent healing of the severed muscles before suppuration has ceased in the higher parts of the wound. Drainage is naturally provided, owing to the character of the injury, and it is, indeed, remarkable how rapidly axillary wounds, and, in fact, all wounds, unite when there is good natural drainage assisted by gravity.

Lameness may persist for some little while, particularly if there be injury to the large nerve trunks, but complete recovery is, in our experience, the rule.

A complication of thoracic wounds which may lead to errors in diagnosis is the existence of emphysema. This condition may occur quite independently of puncture of the chest wall, and very frequently results from laceration of the muscles.

Sternal Fistula.—This very grave condition is dependent upon infection of the sternum, with subsequent necrosis.

It is usually associated with a primary wound, but in some cases bruising produced by falls or by lying upon blunt objects may be the cause.

In the former case necrosis is usually an extension of cellulitis.

There is usually moderate swelling of the sternal region, associated with the formation of a number of narrow sinuses which extend to the sternum. In many cases these occur at the front of the chest as well as on the lower surface between the arms.

In three cases examined post mortem a varying set of lesions was present.

The first case was that of a heavy draught horse, and a sinus had persisted for several months. The skin and subcutaneous tissues were firmly adherent over the middle line of the sternum, and the latter were greatly thickened and had a gelatinous appearance. The cartilage of the sternum was necrotic, as was also the greater portion of the surface of the bone.

In the second little or no necrosis was evident, but the whole of the connective tissue and portions of the pectoral muscles contained large abscesses, which did not intercommunicate. The largest of these, situated over the right costal cartilages, would easily have contained a pint of pus. The smaller ones were very deeply situated, and could not be detected on palpation during life. The character of the pus and the type of lesion pointed to infection by bothryomyces, but unfortunately no microscopical examination was made.

In the last case the lesions resembled those just described, but a sinus of the diameter of a lead pencil penetrated the spongy centre of the sternal bone, where a large abscess cavity existed. Several of the larger abscesses communicated with this by means of small sinuses.

In a case at present under treatment six sinuses are present, three opening at the front on a level with the highest part of the cariniform cartilage, and three on the lower wall of the chest. Through the latter a 12-inch probe touches the body of the sternum, but in the case

PLATE III.

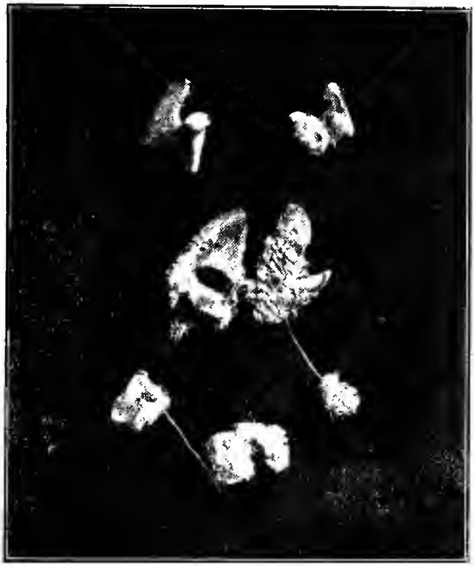


FIG. 14.—*Top, left:* Articular portion of right maxilla of a horse (normal). *Top, right:* Articular portion of left maxilla, the result of chronic open synovitis. *Centre:* Two halves of front half of sternum of a horse, showing central abscess cavity, fistulous opening, and exostosis of surface (see page 86). *Bottom, left:* Articular surface of os coronæ, from a case of septic coronitis. Note fistulous opening through which probe is inserted (see page 86). *Bottom, centre:* All that remained of front half of sternum; sternal fistula (see page 86). *Bottom, right:* Odontoma removed from base of an auricular fistula (see page 77).

To face page 86.

of the former long, tortuous channels run through the connective tissue, and after a course of about 28 inches eventually communicate with those on the lower wall.

Syringing with iodine solution appears useless, and the condition persists indefinitely unless radical surgical treatment is enforced, and sometimes even in spite of it.

After casting the animal in the dorsal position and anæsthetizing, the original sinus should be laid open right down to the sternum with a long probe-pointed bistoury. Long probes should then be inserted to the bottom of each sinus, and the operation wound extended until each centre of necrosis is exposed. Sometimes this necessitates laying open the whole of the tissues from the front of the chest back almost to the xiphoid cartilage, but such a procedure is absolutely essential to successful treatment. Hæmorrhage, although fairly severe, is seldom dangerous. The exposed sternum must then be thoroughly scraped with a strong curette and cauterized with a hot iron. The wound may be temporarily plugged and sutured, but after twenty-four hours should be left quite open and exposed by day. At night a many-tailed bandage should be applied to avoid soiling.

Such cases are always very difficult to treat, and prognosis must be very guarded. It is wise before commencing treatment to consider the cost of a prolonged convalescence. Animals of little value may usually be worked for some time without showing any marked lameness after the acute stage has passed.

Costal Sinus.—This condition may occur from direct injury to the surface of one or more ribs, from kicks or falls, or from secondary infection from pus burrowing from the region of the neck or withers. It is characterized by a hard, tumour-like swelling, from which pus issues through a narrow channel.

The external surface of the rib is usually affected, but in some cases recorded pleurisy occurred from extension of necrosis to the pleural surface.

When treatment is demanded, the swelling must be incised by inserting a probe-pointed bistoury into the depth of the sinus and cutting in a downward direction through the extent of the swelling, following the course of the rib.

The necrotic portion must then be scraped and the rib painted with a strong solution of iodine.

If this treatment fail, excision of a portion of the rib is the only other course, but it is an operation which should not be lightly ventured upon in equine patients.

SADDLE AND HARNESS WOUNDS ; SITFASTS.

Wounds arising from friction of harness are seldom very serious if attended to in their early stages, and if due attention is paid to the harness itself, with a view to removing the cause of pressure.

In many cases, however, infection results, and serious consequences may ensue. In addition to the ordinary pyogenic organisms, bothryomyces frequently gain access to the wound or abrasion, and give rise to the so-called " shoulder tumours." Tetanus bacilli are not uncommonly introduced by friction of the saddle or pad, and cases have been noted in which several consecutive animals have become affected with tetanus through wearing the same harness.

Pressure necrosis may occur as the result of a badly fitting pad or saddle, with the production of a " sitfast."

Treatment must be directed towards removal of the cause and the application of astringent antiseptic lotions. Salt and alum together make a useful lotion, or lead lotion, " white lotion," or dry dressings, may be employed.

Sitfasts are usually surgically removed, but, as it is always uncertain how far the necrotic changes extend, it is often as well to assist Nature to cast off the slough, and thereby obtain healing. To this end, warmth and moisture in the form of hot fomentations will assist. Kaolin made into a paste with hot water and a little glycerine, applied moderately hot and covered with a piece of oiled silk, is one of the best applications. After removal of the necrotic skin, healing occurs by granulation.

PERFORATING ABDOMINAL WOUNDS.

These may be divided into three classes:

1. Wounds which penetrate the peritoneum without injury to the abdominal contents.
2. Those attended by prolapse of portions of the abdominal contents without injury.
3. Those in which there is injury to the abdominal contents, with or without prolapse.

Of the first class we meet with cases in the larger animals, resulting from their being " staked " by collision with sharp posts or rails, from injuries inflicted by bullock's horns, shot or shell, ploughshares, harrows, stable forks, etc., or from falling or lying on sharp objects.

Among carnivora such injuries frequently arise from kicks, gunshot wounds, from injuries maliciously inflicted, and as ordinary laparotomy wounds.

The susceptibility of the peritoneum to infection varies in the different animals, that of the horse being particularly sensitive. Ruminants in many cases will survive extensive injuries to the peritoneum and prolapse of the internal organs if surgically treated. Carnivora, whilst not nearly so susceptible as equines, are far more so than ruminants.

Perforating abdominal wounds in all animals must be viewed with suspicion, and a very guarded prognosis is advisable.

Treatment.—Small animals may be examined in a dorsal or lateral recumbent position, preferably whilst under the influence of an hypnotic, as morphine and hyoscine. The administration of chloroform is attended by considerable resistance and straining, and its use is therefore inadvisable. Horses and cattle should receive a hypodermic injection of morphine or from 1 to 2 ounces of chloral hydrate, and before casting a sheet should be bound tightly around the abdomen.

If upon examination there appears to be no injury to the internal organs (a decision can seldom be arrived at with certainty), the skin should be thoroughly disinfected with tinct. iodi, but no hair should be removed, owing to the danger of particles entering the wound. The edges of the latter should be mopped with successive swabs of cotton-wool until apparently clean, and then painted with Lematte's Solution A or tincture of iodine diluted to a third of its strength. Washing must be carefully avoided, as contaminated fluid will enter the peritoneal cavity.

The muscle must then be sutured with sterilized interrupted sutures of silk, the ends of which should be left sufficiently long to emerge beyond the skin wound. It is not advisable to carry the needle right through the deep layer of muscles, as the suture material might then be a medium for infection of the peritoneum.

The skin wound must next be sutured. In large animals quill or button sutures are preferable, as a heavy strain is brought to bear upon them, but in carnivora interrupted sutures of silk will answer the purpose. It is well to omit a suture at the lowest point of the skin wound to allow of drainage, and through this gap the ends of the muscle sutures should pass. If thought desirable, a strip of sterilized gauze or a drainage-tube may be inserted between skin and muscle to emerge at this point. The free ends of the muscle sutures should be twisted together and tied into a knot. In this way they assist in providing drainage, and when they become disengaged from the muscular tissue they may be removed by traction without disturbing the skin wound. The latter should then be powdered with iodoform, and a thick dressing of sterile wool applied over all and kept in position by a wide bandage, sheet, or runner towel. In horses a clean waterproof carriage-rug is handy, and in carnivora oiled silk or mackintosh material may be applied over the bandage to prevent soiling.

The dressing should be examined daily, without disturbing the wound more than is necessary. As soon as it shows signs of discharge it should be removed, and the wound swabbed clean with wool moistened with Lematte's Solution A or with petrol, drainage attended to, and a sprinkling of iodoform applied before replacing the wool and bandage. Should the amount of discharge become excessive, some or all of the skin sutures should be removed, after securing the animal in the dorsal recumbent position and adopting the same precautions as before. The wound should then be thoroughly swabbed until clean and dry. If the muscle has healed by this time, the skin sutures may be done away with and a fresh dressing applied.

Should peritoneal infection occur, symptoms will be observable in horses after a period ranging from a few hours upwards. In cattle and the smaller animals a longer time usually elapses between infection and the occurrence of symptoms of peritonitis.

In this case the patient should be again placed under the influence of a sedative, and the wound carefully examined. If the muscle wound has not united, the stitches should be removed and the peritoneal cavity flushed out with a considerable quantity of sterile normal saline solution at body temperature. We have irrigated the peritoneal cavity of cattle with a weak solution of potass. permanganate with complete success and subsequent recovery. Weak solutions of iodine ($\frac{1}{2}$ per cent. in pot. iodid. solution) may be used, but its irritant action must be remembered. A strong solution of iodine applied to the visceral peritoneum is in itself sufficient to cause inflammation and adhesions between the serous coats. The whole of the fluid injected should in all cases be drained out before reapplying sutures.

Horses very rarely recover after peritonitis has set in, dogs do so occasionally, and cattle frequently.

No attempt at establishing drainage from the peritoneal cavity is likely to succeed in our patients, and owing to our inability to keep animals in the dorsal position, prolapse of the viscera would be liable to occur were the muscle sutures omitted. If it become necessary to repeat the irrigation on the following day, it is better to make a small fresh incision in another part of the abdominal wall.

Wounds of the abdominal cavity attended by prolapse, but without further injury to the viscera, in horses usually terminate in peritonitis and death. We have, however, seen two cases in which extensive prolapse and considerable soiling of the protruding bowel occurred which, after treatment, were followed by recovery. Cattle frequently recover after surgical treatment.

Treatment.

The prolapsed portions of viscera must be protected as far as possible by the application of clean towels or sheets. A powerful sedative should then be administered, and the animal secured in the dorsal position.

It will then usually be found that the protruding organs are more or less strangulated, tumefied, and tympanitic. Very frequently omentum forms the bulk of the mass.

The skin for some distance around the wound should be sterilized by the application of iodine and covered with a clean sheet, which should surround the opening. Omentum, if protruding, should be further withdrawn, tied tightly in the clean tissue with a sterile silk ligature, and cut off. The stump is then returned to the abdominal cavity, and the muscle and skin sutured.

Intestines must be drawn out a little further (if narcosis is not complete this will be found unnecessary, as the struggles of the animal will cause a serious prolapse) and well washed with normal saline solution at body temperature, care being taken that none enters the cavity through the wound. This may be avoided by packing a clean towel tightly around the intestines at the point where they emerge. We have used warm milk for washing the intestines in cattle on one occasion when clean water was not available, with a successful termination. The parts must next be dried off with clean cotton-wool. In order to return the intestine, it is usually necessary to enlarge the opening, particularly the muscle wound, with a herniotome or probe-pointed bistoury, and to replace the bowel inch by inch. Further treatment will be on the lines previously described. Great care must be taken in suturing the abdominal wound that no portions of intestine become trapped in the muscle wound during the animal's struggles.

If it be found impossible to effect their return owing to strangulation, the protruding organs should be covered by a cloth soaked in *cold* normal saline solution containing some adrenalin, which has a marked effect in relieving the local congestion. If tympanites be excessive, the most prominent loop should be punctured with a hypodermic needle or very fine trochar and again washed. It is advisable, however, to adopt puncture as a last resort, after other means, such as enlarging the wound, have failed. When attempting the latter, care must be taken to prevent blood entering the peritoneal cavity.

In cases of abdominal wounds with injury to the viscera, either within the abdominal cavity or to the protruding portions, it is well to first consider whether it will be worth while to proceed with treatment or whether it will be better to destroy the animal. In horses destruction is always advisable under such circumstances.

In oxen and dogs treatment may be successful if the injury be not very severe. In the latter the small diameter of the intestine is favourable to successful suturing. Portions of bowel which have been merely incised may be united by Lembert's sutures, but if the parts are lacerated or badly bruised they should be resected and the serous coats of the free ends brought into apposition by the method described in Moller and Dollar's "Veterinary Surgery and Operative Technique."

CHAPTER VIII

OPEN JOINT AND WOUNDS OF BURSÆ AND TENDON SHEATHS

THE above conditions must, for convenience of description, be divided into acute and chronic types.

Acute cases include those which have recently arisen, either directly, from injury actually involving the joint cavity, or indirectly, as the result of suppuration in neighbouring tissues extending to the joint.

In the first example, when the joint is newly opened, the synovia which exudes is at first clear, straw-coloured, and slightly "oily" to the touch. On movement the flow increases and the synovia becomes frothy. Upon contact with the air, it coagulates just below the site of the wound into greyish or yellowish clots, which have a tendency to adhere to the surface of the skin.

During the early stages of the condition the chief consideration is whether the joint is infected or still aseptic. The size of the external orifice and the nature of the object which caused the wound may aid, to some extent, in coming to a decision.

If the external orifice be small and there be reason to think the wound is sterile, treatment should be directed towards securing rapid healing. We may commence by painting the surrounding skin with tinct. iodi, applying a thick layer of cotton-wool and a bandage over the part, and frequently soaking these with cold water containing an antiseptic and astringent. A solution of alum and permanganate of potash or carbolic acid may be used in this manner, but no attempt should be made to inject fluids of any description into the wound. After two or three days the bandage and dressing may be removed and the wound and discharge carefully examined for any appearance of pus. Should the wound appear aseptic, the edges should be dressed with ol. caryoph., a pad of wool thickly coated with sod. bicarb. applied, and a bandage affixed over all (see "Special Veterinary Therapy," Steffen). This should be left in position until saturated with synovia.

After two or three of these dressings the flow of synovia will probably cease, providing that the wound remains sterile and is of no great size. In this case it is advisable to apply a biniodide of mercury blister, with the object of producing local congestion and swelling.

Should there still be an escape of synovia after adopting the above measures, Bier's hyperæmia treatment will be found of service, providing the situation of the wound admits of its use.

In those cases of open joint which are the result of suppuration in the neighbouring tissues, treatment must follow the lines to be indicated for chronic cases.

In many cases the injury is so situated that a bandage cannot be applied, as when shoulder or stifle joints are involved. Cold irrigation, continuous if possible, is then indicated, or intermittent, with the application of sod. bicarb. and ol. caryoph. in the intervals, followed at the earliest possible moment by the application of a blister. It is advisable to take precautions against the entrance of water into the joint itself whilst fomenting, as it causes great irritation.

Chronic Cases.—Cases of open joint which have been overlooked or neglected usually terminate in suppuration. This process is accompanied by thickening of the synovial membrane, followed by ulceration and granulation, conditions which eventually terminate in anchylosis, partial or complete, if the patient survive the ordeal. Systemic disturbances, including fever and rapid emaciation, are frequently very marked. Laminitis of the opposite foot often occurs from prolonged standing.

Treatment.

The animal should be at once put in slings. It is essential in all cases of suppurating synovitis to provide adequate drainage. Recovery cannot occur whilst pus can become pocketed in the joint, and as the latter is already infected, no hesitation need be felt in adopting surgical interference.

The interior of the joint should be irrigated with normal saline solution at body temperature until free from pus, and then injected with a ½ per cent. aqueous solution of iodine dissolved by the addition of pot. iodid. or a 1 in 3,000 solution of hydrarg. perchlor. in warm saline solution. The joint cavity should be completely filled with the antiseptic fluid, and the orifice closed for a few seconds whilst the limb is slowly moved in order to distribute the injection. This treatment should be repeated at intervals of five to six hours until pus-formation ceases. Weak astringent antiseptic solutions (zinci sulphocarbolas, zinci or alumini acetas, with 1 per cent. acid. carbol.) may be used alternately with the other injections, or ol. caryoph. diluted with white of egg and normal saline may be used. Autogenous vaccines are undoubtedly helpful in combating the infection.

When suppuration has ceased, the case may be treated on the lines laid down when discussing acute aseptic cases.

To be successful, the treatment of septic arthritis must be prompt and vigorously conducted. If the condition persist for more than a few days, the pathological changes which take place in the synovial membranes and articular cartilage will be sufficient to render the animal permanently lame and of little value. Prognosis must be at all times unfavourable, and the majority of cases, after treatment, require a long convalescence and remain permanently stiff or lame from anchylosis.

Wounds of bursæ and tendon sheaths are treated on the same lines as those of joints. Bursæ, if punctured by " clean " instruments, may be closed by the application of flexible collodion containing hydrarg. perchlor., and the surrounding parts painted daily with tinct. iodi, unless marked swelling or systemic symptoms occur, when the collodion should be removed and " open " treatment adopted.

Wounds of tendon sheaths, if small, seldom give much trouble, unless inflicted by infected instruments such as stable forks, or by kicks from other horses. Antiseptic injections may then be used, and in the event of pus forming, the tendon sheath should be opened. We have obtained especially good results from vaccine treatment in cases of suppuration occurring in the sheaths of the perforans and perforatus tendons after all other means have proved unsatisfactory.

Excessive granulations occurring in cases of open joint and wounds of tendon sheaths may be removed by the application of equal parts of carbolic acid and glycerine cautiously applied.

A common sequel to any of these wounds is the persistence of a small fistula, perhaps of a diameter no greater than that of a match-stem, through which clear synovia is constantly discharged. These are often very difficult to heal. The edges of the orifice should be touched with silver nitrate and Bier's treatment energetically carried out, whenever possible, in order to produce swelling and closure. If the situation of the fistula renders this impossible, a blister should be applied, or the wound may be repeatedly painted with ol. caryoph.

Sometimes suturing the orifice, after making a slight incision in the skin on either side of it, will prove successful. The joint, when possible, should be subsequently bandaged, to avoid movement.

Some practitioners record good results from the application of slaked lime. A dry dressing of alum, zinc. oxid., and starch applied on wool and retained by a bandage gives equally good results.

CHAPTER IX

WOUNDS OF THE LIMBS

WOUNDS OF THE SHOULDER REGION.

LACERATED wounds of the shoulder muscles are not uncommon as the result of collisions. The shoulder joint itself is, however, seldom opened, as it is protected by the surrounding muscles, notably by the tendinous portion of the biceps. The bursa underlying this tendon may occasionally be wounded by deep punctures, but such instances are rare. Punctured wounds of the tissues overlying the shoulder joint may be caused by blows with pitchforks, etc., and owing to the large amount of frothy pus which exudes, particularly during movement, one may be erroneously led to believe that the shoulder joint itself has been opened. Exercise and fomentations are the best treatment for this class of injury, and, providing that infection does not extend further, recovery occurs after one or two weeks.

On the other hand, pus-formation may occur in the bursa intertubercularis, and terminate in abrasion of the cartilage and necrosis of the tendon of the biceps, with chronic lameness. In some cases a sinus may appear at about the middle of the scapular region. This on being opened will in most cases lead to some splinters of bone which have become detached from the spine of the scapula as the result of a blow. After their removal recovery is the rule.

WOUNDS OF THE ELBOW.

Wounds of the point of the elbow may be caused by contact with the inner heel of the shoe whilst lying or during the act of falling, or by kicks or other forms of external violence. If they penetrate the layers of the skin, they may cause injury to the bursa which overlies the summit of the olecranon. Suppuration of the bursa then occurs, and a mass of granulation tissue develops within the wound, producing what is commonly termed "capped elbow." Through the midst of this enlargement a sinus usually persists, and provides an exit for the escape of pus. Surgical operation is usually recommended for this condition, with the object of destroying the walls of the bursa, but good results are often obtained by the application of ung. hydrarg, biniodid. 1 in 8, applied on gauze once or twice at an interval of three or four days, the wound being subsequently dressed with a mixture of turpentine 1 part, olive oil 4 parts. This latter preparation has a remarkable power of reducing excessive granulations in such cases.

Sometimes, instead of a thickened granulating swelling, an ordinary wound persists just below the point of the elbow which discharges a very large amount of thin, frothy pus, which covers the hinder portion of the limb even below the knee. The discharge increases upon exercise. A probe introduced into the wound discloses a sinus several inches in extent which runs in an upward direction.

As the injury depends upon pressure from the heel of the shoe in most cases, a straw band may be wound at night around the cannon, or the shoe may be removed or covered by a padded bandage. One of the patented appliances for the prevention of capped elbow may also be found useful.

We have obtained good results by injecting the sinus occasionally with 10 per cent. solution of silver nitrate.

In some cases both elbows are affected simultaneously, and it is possible that falls are responsible in the first place for the condition, which is subsequently aggravated by pressure of the shoes. We have observed cases in horses which were in the habit of sleeping standing, and which sometimes fell in the stable during the act. As these horses never laid down in the ordinary way, this was probably the cause of injury.

Wounds in the neighbourhood of the elbow may involve the capsule of the joint, which is comparatively superficial, or may merely extend to the fascia.

Wounds of the elbow joint are always serious, and the proportion of recoveries is small. They must be treated on the lines already laid down for cases of open joint. Owing to the presence of the thick fascia which covers the forearm, the elbow joint may become infected without actual injury to the skin in the immediate neighbourhood, and synovia may find an exit at any part of the forearm, sometimes even quite close to the knee. Such cases are liable to be diagnosed incorrectly, but the escape of a fluid from this region, at first clear and with a tendency to coagulate, and which later becomes purulent and frothy, should always occasion suspicion.

Compound fracture of the olecranon process of the ulna sometimes occurs as the result of kicks. These are usually hopeless, but if the injury be confined to the summit useful recovery may occur by fibrous union after prolonged rest. In nearly all cases where the injury is in the lower two-thirds of the olecranon, the fracture extends to the articular surface.

WOUNDS OF THE FOREARM.

The extensor muscles of the forearm are sometimes severely lacerated through contact with sharp bodies, such as upturned ploughshares, galvanized iron, and occasionally by kicks from other horses. In some instances the muscles may even be torn away sufficiently to hang below the level of the knee. In such cases the periosteum and surface of the radius are usually involved, and after the wound has been sutured and has partially healed abscess-formation occurs, with exfoliation of bone, particles of which may be cast off at intervals during a period of months. These abscesses usually break through the skin covering a part of the wound which has already healed. Ultimate recovery is the rule, and it is surprising how little is the resulting deformity even after very extensive injury.

Wounds of the inner side of the forearm are usually complicated by secondary infection occurring in various portions of the fascia. Abscess-formation may occur below the original wound, and is associated with necrosis of the fascia. Thus, successive suppuration centres develop. Free incisions, with due regard to the disposition of important vessels, the provision of drainage, and the use of hot fomentations, usually bring about recovery. Hot kaolin poultices are often of assistance when extensive bruising of the fascia is present. In some cases the median or ulnar nerve may be injured or severed, and neuroma-formation may occur, with chronic lameness as a sequel, unless operative measures prove successful. In the majority of cases, however, union of the divided ends occurs sooner or later.

We have observed chronic radial paralysis follow healing of an extensive wound of the upper part of the forearm, possibly through injury to branches of the musculo-spiral nerve supplying the extensor muscles.

WOUNDS OF THE CARPAL REGION.

The front of the knee is commonly injured as the result of a fall. Prognosis depends upon the depth of the wound and the degree of contusion. In the majority of cases the skin and fascia alone are injured, but the joint may be opened either at the time of the accident or as the result of suppuration extending from the fascia.

The treatment of broken "knees" must vary somewhat according to the extent of the injury.

Contused wounds which do not penetrate the joint are better left unbandaged, and should be irrigated several times daily, preferably by means of a hose-pipe, and they should subsequently be dressed with an astringent, such as lead and alum lotion. Acetate of lead and alum, of each 1 ounce in a quart of cold water, makes a useful application. Suppurating wounds in which there is extensive necrosis of the contused fascia may be dressed occasionally with powdered permanganate of potash applied on cotton-wool, after removing any loose portions of skin or fascia with scissors.

At all times a careful search should be made for particles of grit or stone.

If the joint has been opened, the hose-pipe should be made use of freely and often. The horse should be placed in slings, and the joint cavity injected with sol. hydrarg. perchlorid. 1 in 2,000, preferably dissolved in spirit and diluted with water. Extensive wounds of the synovial membrane are seldom worth treatment, though in a few exceptional cases the joint may be widely opened and yet be followed by recovery after a lengthy period, without complication or marked lameness. Heavy horses may thus prove quite useful for slow work, but light horses are seldom thoroughly restored to usefulness.

In all cases of "broken knees," after healing is well established, exercise at grass is beneficial, and modifies the degree of adhesion which is likely to occur between the skin and underlying tissues, a process which considerably affects the mobility of the joint and even of the whole limb, and which predisposes to stumbling and to further falls. After epithelium has covered the surface, daily massage with an ointment prepared by mixed soft soap 1 part, vaseline 3 parts, is of assistance, and blistering is also recommended by the majority of practitioners, but probably it is only of service when it ensures a run of grass, excepting in those cases in which considerable thickening remains, when it may aid absorption. Daily massage, however, is usually to be preferred, when circumstances permit.

Synovial discharge from the knee does not necessarily indicate that the joint capsule itself has been wounded. Synovia may exude from any of the tendon sheaths which pass over the carpus. Of these, the sheath of the flexor tendons (carpal sheath) is probably the least likely to be damaged, but when such is the case the consequences are often serious, and the prognosis is equally as grave as in open joint itself. Synovial discharge from the sheaths of the extensor muscles is usually amenable to treatment, although frequently a certain amount of thickening persists. Transverse incisions are not common excepting at the front of the knee, but when they occur in the bend at the back are usually very troublesome, and are either attended by the formation of excessive granulation tissue or by hard, thickened edges which resist healing.

Rest in slings with the knee fixed by means of a leather legging considerably simplifies treatment.

WOUNDS OF THE METACARPAL AND PHALANGEAL REGIONS.

The metacarpus and metatarsus contain a large number of important structures closely bound together by fascia and skin. These include the bone and its two accompanying splint bones, the various tendons and their sheaths, the suspensory and check ligaments, and the various vessels and nerves. The flexor tendons and their sheaths are of especial importance, and the latter are frequently wounded by the misuse of stable forks.

The fetlock region, in addition to the metacarpo-phalangeal sheath at the back of the limb, carries at the front bursæ beneath the extensor pedis and extensor suffraginis tendons, and puncture of these is liable to be mistaken for open joint.

The skin at the back of the os suffraginis is frequently injured by means of ropes, besides being especially subject to that form of eczema known as "cracked heels."

In addition to wounds of an ordinary nature, cases of what has been termed "ulcerative cellulitis" have become very common among army horses on the various fronts. This is evidently the result of a specific infection of the subcutaneous fascia of the lower portions of the limb. The etiology is at present being investigated. The condition is ushered in by swelling of the leg and severe lameness—in fact, the animal can seldom place any weight upon the affected limb. After a few days an abscess develops, generally close to the knee or hock. In the ordinary course this discharges and heals without any abatement of the other symptoms, and is succeeded by consecutive crops of abscesses, each of which usually appears lower down the limb than the last—*i.e.*, in a direction opposed to the course of the lymph-stream. Treatment usually results in failure. The condition runs a very protracted course, and as animals badly affected require such prolonged attention, it has been found more economical to slaughter such cases than to continue treatment (see p. 66.)

Other wounds of these regions are treated on general lines. A leg bath is of great service. Even very small wounds of the metacarpal or metatarsal regions may be accompanied by extensive cellulitis and lameness, which is often the result of periosteal injury or infection. The hot-water bath will be found to give great relief, and the advantageous influence of gentle exercise upon the upward flow of lymph must be taken advantage of when conditions permit. Hot kaolin poultices are also useful. Bandages, when applied, should be loose, and the underlying parts should be well protected with layers of wool. Necrosis of the skin covering the cannon bone is not uncommon as the result of a bandage being applied tightly over a limb which has a tendency to swell.

Severed flexor tendons are fortunately of infrequent occurrence. Providing that portions have not been torn away, several layers of deep catgut sutures should be inserted, and antiseptics should be aimed at. Rest, preferably in slings, is essential. In order to keep the severed ends of the tendons in apposition, the fetlock may be maintained in a position of flexion by means of a bent metal splint and bandages, or a shoe may be fitted with deep turned-down heels, until union is almost complete, when the latter should be gradually lowered until the horse can wear a thin-heeled shoe or tips, which will help to modify the degree of contraction which will ultimately occur in the tendon at the seat of injury.

Division of the metacarpal, metatarsal, or digital arteries can usually be controlled by suturing the skin and bandaging. If hæmorrhage still persists, a large "ginger-beer cork" may be divided lengthways and the convex surface applied over each artery above the level of the wound and covered by a tight bandage, which should remain in position for twenty-four hours.

WOUNDS OF THE SHEATHS OF THE FLEXOR TENDONS.

These may result from stabs inflicted by the pitchfork or by the animal getting the leg over the rough edge of a manger, a sharp "bail," or a piece of galvanized iron. Kicking in the stable or in harness or injuries from the heels of another horse may be responsible. Attempts on the part of laymen with surgical proclivities to relieve synovial distensions or "wind-galls" are sometimes fraught with disastrous results.

Either the carpal sheath of the flexor tendons or the superior, middle, or inferior pouches of the great sesamoid sheath above or below the fetlock may be opened.

The carpal sheath is superficially placed, both above and below the knee on the outer side of the limb, and on the inner side it extends from about 3 inches above the pisiform bone almost to the middle of the cannon. About 4 inches of the tendons at their middle third is unprovided with a synovial sheath.

Wounds of these sheaths discharge a large quantity of synovia, which after twenty-four hours becomes turbid and purulent. Lameness is severe, and systemic symptoms are usually present with rapidly advancing emaciation.

Treatment must be confined to cold irrigation and antiseptic injection. Iodine 1 per cent. in pot. iodid. solution, hydrarg. perchlor. ½ per cent., eusol, or Lamette's Solution B, are all useful.

When the wound is in the upper portion of the synovial cavity, pocketing of purulent synovia occurs, and it is advisable to make a counter-opening at a lower point for purposes of drainage. There can be no objection to this procedure from a surgical point of view, as the tendon sheath is already infected.

As soon as discharge ceases, a blister may help to close the orifice, but upon the first sign of abscess-formation the wounds should be reopened.

We have obtained very successful results from the administration of autogenous vaccines, and they are certainly worthy of trial in all cases of open synovitis which do not respond readily to ordinary surgical treatment.

WOUNDS OF THE HIND LIMBS.

Wounds of the quarter and buttock are not uncommon. In the former, drainage is often unsatisfactory and opposed to gravity, and in cases when it is impossible to effect counter-openings, copious flushing and the frequent renewal of absorbent plugs must be relied upon.

Wounds of the buttock are quite common, especially amongst "kickers." They usually unite very satisfactorily, and seldom give trouble, providing that the tuber ischii be not involved.

The external angle of the haunch is often wounded by collision with doorways and gates and by falls. Frequently the bone is splintered, or later exfoliation occurs, after external healing is nearly completed. Fistula-formation then results. Sometimes, as depicted in Fig. 21, a large almost circular area of skin becomes necrotic and sloughs away, usually exposing a central sinus.

Removal of the portions of bone is essential, and in cases where necrosis of the extremity had become widespread we have obtained successful results by removal of the entire piece by means of the bone-saw through a V-shaped flap, the angle of which pointed downwards. Healing is usually complete in from six to eight weeks.

Wounds of the Stifle.

These commonly result from kicks. Contused wounds thus produced cause severe lameness and a considerable degree of inflammation and swelling. Contused wounds of the front of the stifle are very common among horses tied on "lines."

A synovial discharge is common, and may proceed from the femoro-tibial or femoro-patellar joint; but in the great majority of cases it has no connection with either, but issues from the tendon sheath of the extensor pedis, and in some cases from the prepatellar bursa.

Compound fracture of the patella has been described, but is very rare.

Rest in slings and the use of the hose-pipe and astringent lotions is advisable until the flow of synovia ceases. This usually takes from a few days to a fortnight. After this a biniodide blister and walking exercise usually completes recovery. Too early closure of the wound results in the formation of an abscess, capable in some cases of holding several pints of pus.

Synovial discharge from any of the articulations is a very serious matter, and prognosis must be very grave. Treatment is similar to that described above.

WOUNDS OF THE TIBIAL REGION.

Owing to the presence of a very thick fascia underlying the skin in the tibial region, and to the fact that the tibia itself is covered by thin skin and fascia only, on

PLATE IV.

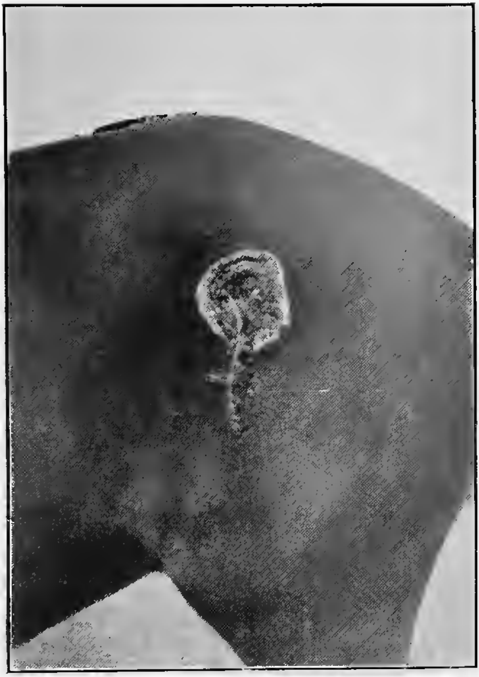


FIG. 15.—Necrosis of antero-external angle of ilium with formation of a fistula.

To face page 110.

the inner aspect of the limb; injuries to this region, although apparently of but slight importance at first, frequently develop into very serious cases. Wounds of the external surface may penetrate the fascia, with the result that portions of muscle protrude whilst the limb is flexed, and become strangulated when the animal assumes the normal standing position.

Excessive granulation then occurs and obstructs the exit of discharges, which burrow down the leg beneath the fascia and produce secondary infection and abscess-formation. On the inner surface of the limb, kicks and injuries inflicted by bails and poles, even if they do not actually produce a wound, give rise to intense cellulitis and usually terminate in abscess-formation. Necrosis readily occurs in the neighbouring fascia, and so successive crops of abscesses develop, each usually at a lower level than the preceding one. Severe lameness generally accompanies this condition. In some cases the periosteum or the bone itself may be injured. In the former case exostoses develop on the surface of the bone, whilst in the latter, providing that actual fracture does not exist, exfoliation of small pieces frequently occurs. As these are usually thrown off beneath the fascia, their escape is rendered difficult, and abscesses develop, through which the particles, if not too large, usually find an exit.

Treatment must aim at providing drainage, and to this end free incision of the fascia is advisable, using a grooved director and bistoury for the purpose, to avoid injury to the neighbouring vessels. Hot fomentations encourage abscess-formation, but we have obtained the best results by surrounding the tibial region with a kaolin poultice. A piece of waterproof material is securely fastened around the leg immediately above the hock by means of a bandage, and is supported at the top by tapes fastened to a crupper. The bag thus formed is then filled with kaolin made into a paste of the consistency of thick cream. The following makes a useful application for any purpose for which a hot poultice is required:

℞	Kaolin. pulv.	lbs. ii.
	Sodii chlorid.	āā ℥ii.
	Acid. boric.	
	Glycerin.	℥ii.
	Theriacæ	℥iv.
	Aqua calor.	q.s.

M, Ft. Cataplas.

This application will retain its heat for a period of twenty-four hours, and does not require frequent renewal, as do hot fomentations. Excessive granulations on the outer side of the tibial region may be removed with a scalpel, after which the fascial opening should be enlarged and an astringent dressing applied. A pressure bandage is of assistance, when the form of the limb allows of its being retained in position. The majority of tibial wounds recover, though many require a considerable period in which to heal.

WOUNDS OF THE TARSAL REGION.

Wounds of the hock may be of slight importance or very grave in character according to the structures involved and the degree of infection. We may summarize the various anatomical structures which may be involved as follows: (1) Skin; (2) skin, with injury to or infection of the underlying fascia; (3) the true hock joint; (4) any of the other articulations; (5) subcutaneous bursa of point of hock; (6) tendon sheaths of perforatus and gastrocnemius above or below point of hock; (7) perforans sheath at inner side of hock at back of astragalus; (8) various other smaller tendon

PLATE V.

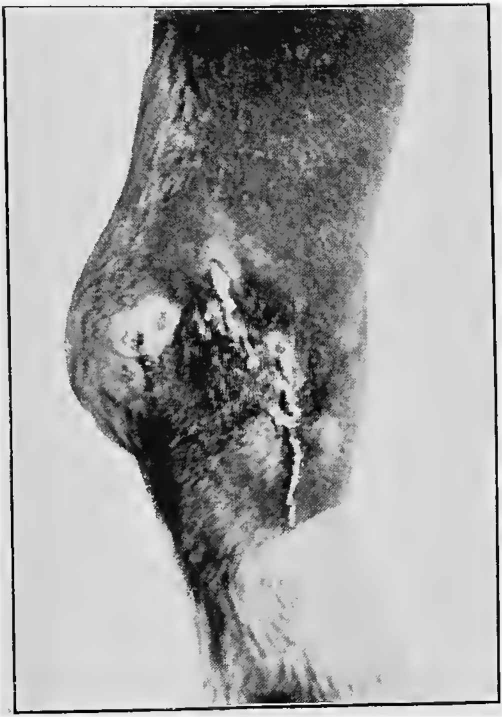


FIG. 16.—Septic cellulitis of the hock.

To face page 112.

sheaths; (9) saphena vein, metatarsal artery and posterior tibial artery.

Wounds involving the skin of the hock alone are seldom serious, excepting when they occur at the front of the hock or on the point of the os calcis. Transverse wounds of the front are troublesome owing to constant movement giving rise to excessive granulation. Astringent lotions or dry dressings and rest in a box or stall are usually sufficient. A much more serious injury may be caused by a shallow punctured wound, extending into the fascia, which is very complete in this region. As a result fascial necrosis occurs, and, as drainage is very inefficient, a chronic suppurating wound becomes established. Kicks on the outside of the hock often produce the same results, through destruction of the underlying fascia. Lameness, in the majority of cases, is only marked during the acute stages, and usually disappears later, unless the inflammatory changes give rise to the formation of a quantity of fibrous tissue subcutaneously, which causes a certain amount of stiffness.

Upon every movement of the limb, thick, creamy pus exudes from the puncture. This condition may persist for many months if untreated, without improvement, and it is usual for secondary superficial abscesses to develop at intervals on other parts of the surface of the hock. After a varying period the discharge becomes less, as removal of the dead tissues is effected, and finally ceases. Recovery may be expedited by carefully laying open the sinus, using a director and probe-pointed bistoury and cutting as nearly as possible in a vertical direction. Sometimes sequestra may be found at the end of the sinus, or occasionally exfoliated particles of bone. Setons are useful if they can be inserted, but, as the sinus usually takes a downward and inward direction, this is often a difficult matter.

We have not observed any good results from the use of fomentations, poultices, or external applications, but exercise is certainly beneficial, as it favours drainage and the discharge of necrotic material.

Wounds of the True Hock Joint.

The synovial capsule of the tibio-tarsal articulation possesses several distensions which lie close to the skin and are easily wounded by kicks or prods from forks, etc. Infection of the synovial cavity may also occur by extension from neighbouring tendon sheaths. On the outer side of the hock a protrusion of the synovial capsule is present at the posterior portion of the articular surface of the tibia on a level with the point of the os calcis. On the inner surface of the joint there are two

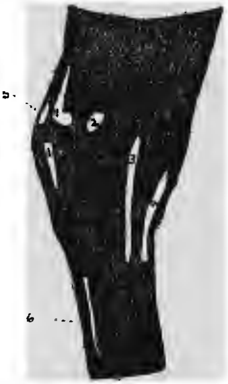


FIG. 17.—DIAGRAM ILLUSTRATING THE POSITION OF THE TENDON SHEATHS AND BURSÆ OF THE OUTER SURFACE OF THE HORSE'S HOCK.

1, Tendon sheath of perforatus and gastrocnemius; 2, protrusion of synovial capsule of the true hock joint; 3, tendon sheath of peroneus; 4, tendon sheath of extensor pedis; 5, bursa calcanea; 6, sheath of flexor tendons.

protrusions, one lying in front of and in apposition with the sheath of the perforans tendon, a little below the level of the tuber calcis; and the other on the antero-internal aspect of the joint, partly covered by the flexor metatarsi tendon. Wounds of the synovial cavity of the true hock joint must be treated on the lines previously laid down when discussing open joint.

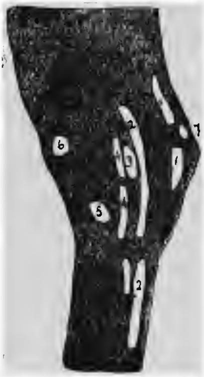


FIG. 18.—DIAGRAM ILLUSTRATING THE POSITION OF THE TENDON SHEATHS AND BURSÆ OF THE INNER SURFACE OF THE HORSE'S HOCK.

1, Tendon sheath of perforatus and gastrocnemius; 2, tendon sheath of perforans; 3, protrusion of synovial capsule of the true hock joint; 4, tendon sheath of flexor accessorius; 5, sheath of inner tendon of flexor metatarsi; 6, protrusion of synovial capsule of the true hock joint; 7, bursa calcanea.

Prognosis must be guarded, and depends chiefly upon whether the synovial cavity remains aseptic. In most cases it becomes infected at the time of the injury, and treatment is then more or less useless. Rest in slings, continuous cold fomentation, and injection of antiseptics, give the best results. Apart from the difficulty in obtaining asepsis and healing, the articular cartilages of the astragalus and tibia rapidly become ulcerated, and, as lameness and disease of the joint become established, the animal becomes worthless.

Injury to the synovial membranes of the lower tarsal articulations is not so common, owing to the close apposition of the bones almost throughout their entire surfaces. Prognosis is more favourable than in cases of injury to the tibio-tarsal articulation, and if ulcerative processes should develop in the articular cartilages, anchylosis usually follows after a more or less prolonged period. Providing that the condition does not extend to the surfaces of the astragalus and tibia, recovery may occur, and although the joint may be incapable of being fully flexed, yet the animal may remain workably sound.

The subcutaneous bursa at the point of the hock may be wounded, and injuries of this nature usually produce a considerable degree of lameness, especially when a transverse incision occurs. Simple bruising of the bursa produces the condition known as " capped hock " —*i.e.*, an excessive production of fluid within the bursa. Should this become infected, abscess-formation results, and eventually a sinus with thick granulating walls becomes established. In simple incised wounds of the cap of the hock suppuration occurs readily, and in many cases infection extends to the neighbouring tendon sheaths, particularly to the sheath of the perforatus, which lies directly over the tuber calcis, and less frequently to that of the perforans. Lameness then becomes very marked, and may persist for many weeks. There is then considerable swelling of the cap of the hock. A fine probe can usually be inserted through a narrow opening into the perforatus sheath, and from this a discharge of purulent synovia issues.

Cold irrigations and as little interference with the wound as possible during the early stages give the best results, followed later by astringent antiseptic lotions, and eventually by a biniodide of mercury blister. The injection of antiseptics irritates the wound and increases the lameness. The sinus produced in a "suppurating capped hock" does not so frequently extend beyond the superficial bursa, and lameness is not usually very marked after the acute stage has passed. The daily injection of turpentine in olive oil (1-4), together with cold fomentation and the external application of lead and alum lotion, usually diminishes the swelling and discharge, when the part may be blistered with biniodide of mercury ointment.

Wounds of the sheath of the perforatus tendon are of fairly common occurrence, quite apart from injury to the point of the hock. The tendon sheath is comparatively superficially situated for 4 or 5 inches above the tuber calcis on both sides of the limb, where it lies in contact with and directly in front of the tendo Achillis. Below the point of the hock it extends, covered by the tarsal fascia, for 2 or 3 inches beneath the perforatus tendon, beyond the edges of which it protrudes. Punctured wounds of the upper portion of the bursa, in front of the tendo Achillis, are not at all uncommon, and are usually inflicted carelessly or maliciously by the stableman with a pitchfork.

The visible symptoms are severe lameness and swelling and the discharge of synovia, which later becomes purulent. Usually, after a period ranging from a few days to a week, an abscess develops on the inner side of the hock, below the tuber calcis, corresponding in situation to the lower portion of the tendon sheath. The majority of cases recover under treatment, but in a few recovery may be only partial, as chronic lameness may persist as a result of ulceration of the cartilage covering the tuber calcis and injury to the face of the perforatus tendon by constant friction. Many cases, however, show no bad after-effects. The formation of an abscess in the lower part of the tendon sheath must be regarded as beneficial, as it provides drainage.

Treatment.—Cold applications or, better still, the use of the hose-pipe are helpful throughout the whole course of healing. Injections are not advisable, unless an abscess has developed in the lower portion, as the fluid pockets and has no means of escape. When there is drainage, however, injection of 1 per cent. iodine solution is beneficial, and in protracted cases we have obtained good results by passing a seton, smeared with iodine ointment, from the upper wound through the sheath and out through the lower one. A long, eyed probe is the best instrument for its insertion. At the same time a mild biniodide blister may be applied to the hock and fomentations discontinued. In other cases the application of wool saturated with an astringent lotion, as lead and alum, and kept in position by means of a bandage, in the intervals between the cold fomentations, has been successful.

Recovery should be complete in a month at the longest if the case is to have a satisfactory termination. More protracted cases, in our experience, have remained permanently lame and of little value.

The sheath of the perforans tendon is sometimes injured in the same way, but owing to its being situated on the inner side of the hock it is not so frequently wounded as is that of the perforatus. The symptoms, course, and treatment resemble those of the latter, with the exception that in many cases infection spreads to the outer distension of the capsule of the true hock joint, which lies more closely in opposition with it than does the corresponding distension on the outer side with the perforatus sheath.

Various bloodvessels, of comparatively large calibre, lie in the region of the hock. On the inner side the saphena vein is quite superficial and is sometimes wounded by kicks, during jumping and during the operation of firing. Suturing the skin and the application of a bandage is usually sufficient to arrest the hæmorrhage in the case of a wound, whilst, after firing, hæmorrhage usually ceases spontaneously as a result of the subsequent swelling, or owing to the fact that change in the position of the limb causes the skin to cover the vein.

On the outer side of the hock the metatarsal artery is liable to injury and gives rise to serious hæmorrhage, though, owing to its position, the vessel may be easily compressed. The posterior tibial artery is seldom injured.

The gastrocnemius tendon is in rare cases severed, and cases have been reported of recovery after suturing the tendon with wire and resting the animal in slings, with the hock moderately extended by means of a splint.

CHAPTER X

WOUNDS OF THE FEET AMONG HORSES AND CATTLE

Nail-Pricks.—Pricks occurring during shoeing, caused by misdirected nails, are commonly met with. The part of the foot involved is usually the sensitive laminæ, although from gross carelessness or the results of infection the os pedis or coronary cushion may become affected, with subsequent necrosis.

Apart from the first pain and soreness consequent upon the injury, any lasting effects are the direct result of infection introduced at the time of the injury or later. Owing to the fact that the foot is normally contaminated with earth and fæces, primary infection is unavoidable. Should the lameness increase rather than decrease and become really severe after a few days, the inference to be drawn is that pus-formation has resulted.

Treatment.—Immediately it is known that a foot has been "pricked," the nail should be withdrawn, the shoe removed, and free bleeding should be encouraged (if at the time of the injury) in order to remove any foreign material introduced with the nail. The puncture should then be opened up with a searcher sufficiently to provide drainage and to permit of antiseptic treatment, but not to such an extent as to make matters worse by producing a large opening. A warm antiseptic foot bath may then be employed, after which the puncture should be plugged with cotton-wool soaked in Lematte's Solution A or tinct. iodi. Cotton-wool soaked in a hot antiseptic solution should then be wrapped around the foot and covered with a waterproof material and a canvas bandage.

To apply a bandage to the foot a 2-inch or 3-inch bandage is the most useful, and it should be at least 6 yards in length: 9 is even preferable.

When commencing, the first turn is taken from the heel, leaving a free end of about 9 inches in length. The first turn passes around the foot below the coronary band, around the heel *below* the free end, is twisted over this, and returned in the opposite direction. The next and subsequent turns are carried *above* the free end of the bandage, over which they are twisted, and carried around the foot, each in the reverse direction to the preceding one. Thus, if the first turn commenced at the heel and passed first around the inside of the foot, the second will commence at the heel and pass first around the outside of the foot, after being twisted over the free end at the heel, and so on. Each turn of the bandage should pass over the bulb of the heel at the back, whilst each is carried lower in

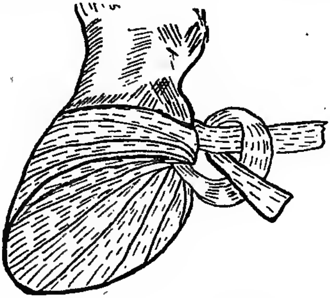


FIG. 19.—THE SOLE BANDAGE.

front than the preceding one, and at an angle more approaching the perpendicular. After about half a dozen turns the foot surface will be reached, and the bandage is then carried over the sole from the heel to each quarter, and eventually from the heel to the toe, so that when completed the strips of bandage covering the ground surface of the foot radiate from the heel in the shape of a fan. A notch cut at the toe, where the toe-clip of the shoe usually rests, helps to maintain the bandage in position. When properly applied, a stout canvas bandage will completely protect the whole of the foot, and will remain in position, if desired, for a week without slipping.

Under this treatment it may be found that the animal continues sound, and after a few days the shoe may be replaced with a leather and a suitable dressing and the animal may return to work. No further trouble may arise, but, on the other hand, after a few days, or even a few weeks, severe lameness may occur as the result of infection and belated pus-formation in the sensitive tissues. The same treatment should then be again adopted, whilst particular attention must be paid to affording complete exit to the accumulated pus and providing efficient drainage.

If, however, the case be neglected at this stage, and if the original nail-tract be not opened up so that the pus may escape through the "white line," further infection will occur in that portion of the foot which underlies the coronary band, and will be evidenced by swelling and fluctuation, usually of that portion of the coronet situated above the original nail-hole. Eventually the abscess thus developed will break and discharge its pus. In a few favourable cases healing will rapidly take place, especially if means be adopted to provide drainage by opening the sole in the neighbourhood of the original injury. In a large number of cases (probably the percentage depends upon the nature of the bacterial invasion) the infection will extend to other tissues, and a chronic sinus in the region of the coronet will result. The most frequent cause of these sinuses is necrosis of the sensitive laminæ, then comes necrosis of the sub-coronary connective tissue, and finally necrosis of the lateral cartilage (with the production of "quittor"). Tetanus is a rather common sequel, owing to the fact that the wound is more or less deprived of air and is in contact with the soil and excreta.

Picked-up Nails, etc.—Apart from pricks caused in shoeing, horses frequently pick up foreign bodies in the feet. The most common are nails, usually bent, rusty, and laden with bacteria, which often include the *B. tetani*. Occasionally the toe-clip of a loosened or cast shoe causes the injury; sharp pieces of metal or fragments of glass may be responsible.

The gravity of the case depends upon the nature of the infection and the situation of the wound.

Owing to the shape of the sole, the nail or other object usually becomes imbedded in one of the lateral lacunæ of the frog, although sharp bodies will penetrate the sole if they come into contact with it at anything approaching a right angle, providing the concussion be sufficient to drive it through. The lacunæ of the frog, however, will allow a sharp body to be retained, owing to their depression, and the succeeding step forces it in an upward direction.

The situation of the various structures which it may encounter must now be considered. Directly above the horny sole and frog lie the sensitive sole and that portion of the plantar cushion which covers the frog and is often referred to as the "sensitive frog."

Superimposed is the bulk of the plantar cushion and above this again the os pedis, navicular bone and its bursa, and the perforans tendon.

The plantar cushion is thickest at the heels and tapers down as it nears the point of the frog, in which situation there is only a thin layer between the horny frog and the os pedis. Between the point of the frog and the toe the plantar surface of the os pedis is in apposition with the sensitive sole.

Roughly, the navicular bone lies above the middle point of the frog, and between them are the perforans tendon and the small sesamoid sheath. On the antero-inferior aspect of the navicular bone and between it and the os pedis is an extension of the synovial membrane of the coffin joint.

A nail perforating the sole at the point of the frog or between it and the toe is therefore most likely to come into contact with the pedal bone. One entering the median or lateral lacunæ of the frog will perforate, according to the depth to which it penetrates, the sensitive frog or plantar cushion; then, in order, the perforans tendon, synovial sheath, navicular bone, and possibly the synovial capsule of the coffin joint. It is therefore necessary that a foreign body should penetrate to a considerable depth in this region before coming into contact with more or less "vital" parts of the foot, such as the tendon, its sheath, or the navicular joint. Were this not the case, wounds of the central area of the frog would always be dangerous, whereas in practice it will be found that only a small proportion inflict really serious injuries, as in the majority of cases the nail does not penetrate beyond the sensitive frog.

Should the puncture occur at the heel or in the interspace of the bars, the plantar cushion will be injured, and if the nail penetrate very deeply in a forward direction, it may reach the perforans tendon.

Puncture of the Plantar Cushion.—A wound of any part of the sole of the foot is naturally infected at the time by the numerous organisms contained in the adherent soil, mud, dust, and fæces.

Assuming infection in all cases, prognosis must be guided by the situation of the puncture, its depth, and the time which has elapsed since the injury was inflicted. Unfortunately, in veterinary practice cases of lameness are not brought in for treatment until the symptoms are well marked, and in the majority of foot cases suppuration has usually become established in the interval which has elapsed between the time of the injury and the time when the owner considers it judicious to call in his veterinary attendant.

Wounds of the sole, at the quarters, usually suppurate at an early stage; but, owing to the small size of the puncture, and the fact that it becomes occluded by dirt and grit, there is no natural exit for the pus, and should the wound not be opened up immediately that suppuration occurs, purulent cellulitis of the plantar cushion may set in, with possibly toxæmia, pyæmia, or septicæmia as complications.

It is obviously impossible to disinfect a nail-track and the cellular tissue involved unless a free passage be made by means of the searcher. Probing of wounds in the region of the foot should be avoided as far as possible, owing to the danger of introducing bacteria from the soiled surfaces. It is also wise to scrub the foot with an antiseptic before proceeding further. The channel should be carefully cut out, the sole being removed in a circle around the nail-hole, care being taken to remove any portion which is underrun with pus. The foot may then be immersed in a warm bath containing eusol, hypochlorous acid 5 per cent., or one of the coal-tar preparations. After removing from the water, the wound should be plugged with cotton-wool soaked in tinct. iodi or eusol solution, and the foot surrounded with a thick layer of wool saturated with a hot antiseptic solution. A layer of oiled silk should then be wrapped over this, and followed by a linen bandage, with a canvas bandage over all. A boot may be used with advantage. At intervals of three or four hours the canvas bandage should be removed, and the foot soaked in hot water for ten minutes at a time to increase the local circulation. Bier's treatment is advantageous in cases which do not improve as rapidly as desired, and in protracted cases autogenous vaccines are indicated. The former is not advisable when pain is very severe, and may be replaced by the application of counter-irritants to the region of the coronet.

In some cases excessive granulation results after removing portions of the sole. These may be removed by the knife and subsequently touched with the actual cautery, or may be dressed with equal parts of carbolic acid and glycerine. A dry dressing should then be applied on cotton-wool and pressure maintained by means of packing and a bandage. If the case has sufficiently improved to permit of shoeing, a strip of sheet-iron, inserted across the foot and under the seating, may be beaten down on to the dressing until sufficient pressure is secured.

In all cases cleanliness and protection of the hoof from external influences are the sheet-anchor of successful treatment.

After suppuration has ceased, the horse should be shod with a seated shoe and a leather over a suitable dressing. A plate of tin or sheet-iron may be fitted, in place of the leather, to slide in and out of the seating, or may be fastened to the ground surface of the shoe by drilling holes in both plate and shoe and inserting screws or frost cogs. This permits of the sole being inspected from time to time.

When the puncture occurs in the region of the frog, the nail may bury itself in the sensitive frog—*i.e.*, plantar cushion—when the treatment will be as described above.

Should it occur at the centre of the frog, prognosis will depend upon its depth and direction, and particularly as regards the possibility of injury to the perforans tendon, small sesamoid sheath, navicular bone, or the articulations.

In either of these conditions, with the exception of superficial injury to the tendon, synovia will sooner or later make its appearance at the site of the puncture.

Synovial discharge is indicated by a frothy or glairy discharge, more abundant when the foot is extended and flexed. At first it is clear, later turbid and purulent. It has a tendency to coagulation.

The escape of synovia from a punctured foot indicates a very grave condition and involves a lengthy treatment, with danger to the life of the patient and possibly chronic lameness as a result.

As in all wounds of the lower extremities, tetanus is a very real danger, and serum should be administered whenever possible.

The synovia may be issuing from the small sesamoid bursa between the perforans tendon and the navicular bone, from the articulation of the latter with the os pedis, or from the synovial capsule of the os pedis at the point where it protrudes between the latter and the navicular bone. In any case, the infection is seldom confined to any particular spot, and unless early drainage is provided it quickly affects the whole articulation.

Treatment.—The first precaution to adopt is to make provision for slinging the animal, otherwise laminitis may occur in the other foot. In practice it is often found that the animal has to be eventually destroyed, owing to descent of the pedal bone of the opposite foot with resulting decubitus. Frequently, owing to the marked lameness in the foot first affected, from the discharge of synovia, these complications pass unobserved until it is too late to adopt remedial or preventive treatment.

No attempt should be made in the early stages to arrest the flow of synovia, as bacteria would thus be imprisoned in the wound. The opening in the horny sole should be enlarged sufficiently to prevent the accumulation of pus, and antiseptic injections should be persisted with. Weak solution of iodine is very useful, alternating with cold normal saline solution containing 2 per cent. ol. tereb. or ol. caryoph. Cold astringent antiseptic foot baths are indicated. A weak solution of cupri sulph., alum, and zinci sulph., makes a good astringent bath. Stock polyvalent vaccines containing the common pyogenic organisms should be made use of at the earliest possible moment, whilst an autogenous vaccine is being prepared, with the object of arresting infection as far as possible before the articular surfaces have been destroyed.

As soon as the discharge appears clear and free from pus, the puncture should be injected with ol. caryoph. once daily, and a bandage applied over plenty of cotton-wool. A very useful injection is made by shaking together equal parts of ol. caryoph., normal saline solution, and white of egg. Bier's treatment should be energetically persisted in at this stage.

If progress be satisfactory, discharge will soon cease, but in the majority of cases a favourable termination is not to be expected for some time. Usually the condition persists for weeks or months, and is complicated by secondary abscess-formation at the bulb of the heel or around the coronet. In most cases lameness persists for some time after the wound has healed, and may become chronic.

After all discharge has ceased, the horse should be shod with a removable plate, and cotton-wool, soaked in an antiseptic, should be packed between this and the foot, and renewed daily. A blister applied to the coronet and exercise in a level field will help to restore soundness.

In chronic lameness following nail-pricks resection of the perforans tendon has been recommended. The technique of the operation is well described in Dollar's "Regional Veterinary Surgery and Operative Technique." The value of the operation is doubtful, and in our hands it has never had the desired result and lameness has always resulted. We have, however, had two cases recover after dividing the plantar cushion in the middle line and introducing a curette, followed by a light application of silver nitrate.

Probably the good results have been due to the excellent drainage thus provided.

Punctures in the interspace between the point of the frog and the toe may reach the pedal bone. Fracture sometimes occurs, but as a rule the injury is not sufficiently severe and local necrosis results, with exfoliation and recovery in a few weeks to a few months, during which time lameness is usually acute. Treatment consists in the provision of drainage, the use of hot fomentations, and, above all, the exercise of patience.

WOUNDS OF THE CORONET AND CORONARY BAND.

Apart from quittor, which will be discussed later, wounds and abscesses of the coronary region are commonly met with. Treads inflicted by the opposite foot or by another horse are frequently the cause; occasionally wheels of vehicles pass over the coronet and inflict injuries which may be of a very grave nature. Abscess-formation in this region sometimes occurs as the result of primary infection, and very frequently as a secondary infection dependent upon infection of the sensitive foot or plantar cushion.

Coronary abscess, sometimes termed "false quittor," seldom occurs as a sequel to foot infection, providing that the prior condition has been diagnosed and steps taken to secure early evacuation of any pus contained in the foot. Cases, however, occasionally occur in spite of these precautions, and are attributable to secondary infection of the subcoronary connective tissue. In many neglected cases the seat of infection is the sensitive laminæ, at the upper part of the wall, and here, possibly from pressure of the pus upon the sensitive structures, but more probably owing to the nature of the infection, necrosis occurs, with the formation of a suppurating cavity. Necrosis may eventually extend to the parachondrium and so to the lateral cartilage, with the production of a quittor; but we have observed cases in which necrosis of the sensitive laminæ directly below the lateral cartilage has persisted for many months without the occurrence of necrosis in the latter structure.

In these cases of "false quittor" the great bar to natural recovery is the absence of drainage. This difficulty may be overcome by drilling a hole through the wall at the lowest point of separation of the laminæ, or through the "white line" in certain cases (where the separation extends to the ground surface), and inserting a seton if desired, to keep the aperture open and free from clots.

Weak tincture of iodine injections and warm antiseptic foot baths are indicated. Recovery is usually a matter of a few weeks, unless necrosis is very advanced, when suppuration may continue for months. Lameness is usually not severe; sometimes it completely disappears after the abscess has discharged its contents.

Abscess-formation in the coronary region as the result of primary infection is a very serious condition.

PLATE VI.

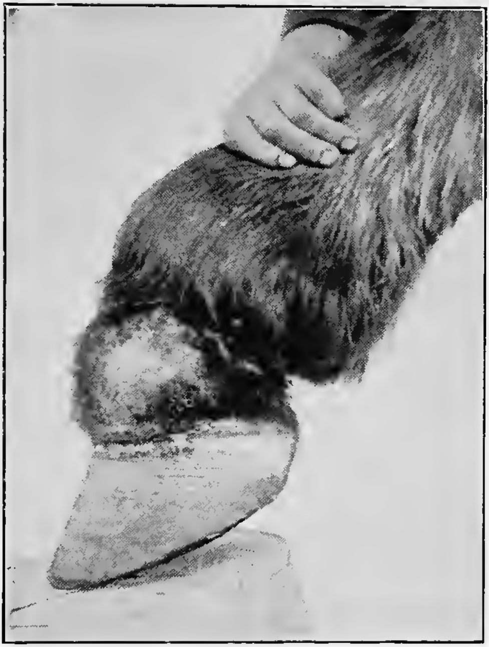


FIG. 20.—Septic coronitis. A drainage-tube has been inserted.

To face page 130.

In all probability the necrosis bacillus is the chief agent in producing the lesions, and possibly gains access to the tissues through wounds or abrasions in the region of the coronary band; at any rate, in such cases no connection with foot injury, corns, or suppuration can usually be traced, and, indeed, it must be stated, in many instances no evidence of injury in any part of the coronary region is evident.

The first symptoms observable are swelling of the coronary band and subcoronary connective tissue, with very severe lameness. The foot is held off the ground with the fetlock and pastern flexed, and no weight is placed on the affected limb. In walking the leg is advanced from the hip or shoulder, the hock and phalanges remaining flexed, and only the tip of the toe comes to the ground. The whole of the coronet region may shortly exhibit a considerable degree of swelling and tenderness. This condition may persist for days or weeks without the occurrence of suppuration; but in a few cases this is one of the earliest symptoms, and may be evident a few hours after the first appearance of lameness. It usually takes the form of a series of confluent abscesses, which discharge a sticky, yellow pus through a number of orifices at various points, just above the coronary band. Septic pneumonia usually develops shortly afterwards, and terminates in death.

Cases have been reported from France in which preliminary lameness and swelling of the coronary band have been followed in twenty-four hours by casting off of the horny foot. In the chronic type swelling of the coronet may persist for weeks or months without evidence of suppuration (see Fig. 20). Eventually one or more soft spots may be found, which, upon being opened, discharge a thin, blackish pus, without affording any apparent relief. This state of affairs may continue for months, one set of abscesses healing only to be succeeded by other crops. The discharge finally becomes continuous, clear, and straw-coloured, and resembles synovia, which in the majority of cases it probably actually is. As no treatment appears of any avail, destruction is the most economical proceeding. Upon post-mortem examination the lesions vary according to the duration of the disease. In cases examined soon after the onset of symptoms, sinuses extending in various directions throughout the swollen subcoronary connective tissue will be evident. The walls usually appear more or less necrotic, and are lined by a gelatinous material. In all cases the os coronæ and possibly the lower third of the suffraginis present evidence of acute periostitis, with the production of exostoses, and this complication is probably the cause of the very severe pain and lameness.

In cases which have been kept alive for nine months we have observed destruction of the upper articular surface of the os coronæ, extending into the cancellated tissue, from which sinuses penetrated the exostoses and communicated with those of the coronet.

Loss of any considerable portion of the coronary band, such as may occur from severe treads, is seldom made good, and results in subsequent deformity of the wall, with the production of a "false quarter." If the band be simply severed, healing may occur fairly rapidly, as the parts are exceptionally well supplied with blood; but if exposed to further injury from brushing or treads, or if allowed to become dirty and badly infected, excessive granulation and swelling results, producing deformity of the band and displacement of the secretory papillæ. As a rule, whilst these active inflammatory changes are in progress secretion of horn ceases, but in some cases it continues, with the result that the displaced papillæ are held in their new position by the new growth of horn. Hence, horn may be secreted in

PLATE VII.

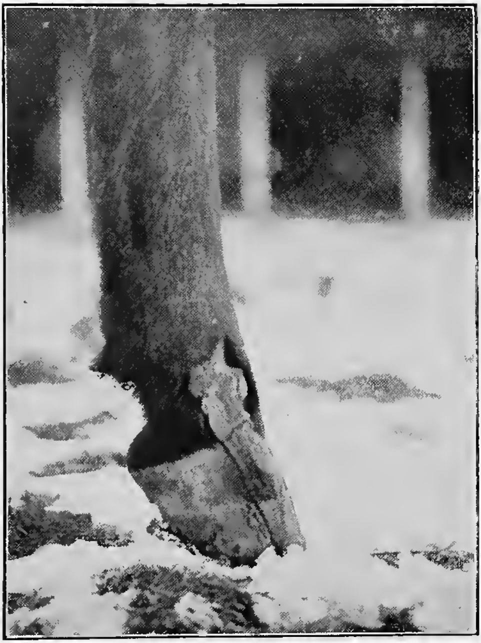


FIG. 21.—Abnormal growth of horn on the coronet and foot of a mule, the result of wounding of the coronary band and displacement of the secretory tubules.

To face page 132.

extraordinary positions, as on the coronet or outside or inside the existing wall, resulting in the latter case in the formation of a keratoma. Fig. 14 represents the foot of a mule, in which a continuous growth of horn was secreted both upon the coronet and upon the wall of the foot as the result of wounding of the coronary band, with displacement of its secreting tubules.

After the "classic" operation for quittor has been performed, displacement of the band may occur, so that the strip of new wall is disconnected from the remainder of the old wall and lies outside it.

Inflammation of the coronary band, with temporary cessation of horn secretion, produces a depression in the newly formed wall, corresponding in breadth with the portion of band involved, and in depth with the time during which cessation of secretion continues.

Necrosis of the coronary band, particularly over the bulb of the heel, sometimes occurs as the result of infection.

The *treatment* of wounds of the coronary band, to be successful, must aim at restoring the secretion of horn after reducing swelling and excessive granulation.

Warm foot baths of salt and alum or of cupri sulph. and alum are most useful to combat inflammation and infection. They also help to prevent the excessive softening of the band which always accompanies this condition, and predisposes to further injury and displacement. An occasional application of tinct. iodi is useful. Tight bandaging is to be avoided, as it encourages necrosis, but a piece of flannel in the form of a Yorkshire boot suspended from the fetlock and left sufficiently long to cover the coronary band may be frequently soaked in an astringent lotion and will help to protect the parts.

PANARITIUM IN CATTLE: WHITLOW, CLAW-EVIL.

This affection of the interdigital space is ushered in by swelling, spreading of the claws, and lameness. The cause is undoubtedly an infection (possibly by *B. necrosis*), which gains entrance through a wound in the soft structures uniting the claws. If the condition goes on to a favourable termination, a wedge-shaped piece of tissue usually sloughs out from the interdigital space and healing occurs by granulation. The majority of cases recover naturally after a period ranging from one to several weeks, but protracted cases are always associated with progressive emaciation, and death sometimes occurs from weakness and decubitus.

In some instances infection extends to the sensitive structures, with the production of a crop of abscesses around the coronet, and possibly extension to the pedal or pastern joints. Sloughing of the wall of one or both claws may also occur.

Treatment.—In simple cases the best results are obtained by spreading the claws, by packing tow in the interspace, and applying a bandage. Ung. cupri oleatis or an ointment composed of cupri sulph. and ol. picis rubbed down with fat may be used, smeared on tow.

Failing this treatment, the actual cautery may be applied to the swelling between the claws, and followed by a dressing as previously described. This facilitates sloughing of the necrosed portion, and is usually successful.

If septic coronitis supervenes, the abscesses should be opened as early as possible, and in some instances a drainage-tube may be inserted under the skin of the coronet to emerge at each side. Antiseptic foot baths, containing astringents such as cupri sulph. and alum, may give relief, and occasional injection of the sinuses with tinct. iodi may be tried.

Amputation of the claw is advised by some observers in such cases, but is liable to be complicated by fresh infection of the divided surface and toxæmia or septicæmia.

CHAPTER XI

FISTULÆ AND SINUSES

CORRECTLY speaking, the term "fistula" denotes an abnormal channel or passage which communicates with a natural cavity on the one hand and with the surface of the body or a second natural cavity on the other. For instance, an "anal fistula" should open into the rectum at one end and upon the skin in the region of the anus at the other end; or, as in the case of a recto-vaginal fistula, it may establish communication between two natural channels—viz., the rectum and vagina.

A "sinus" is an abnormal passage which opens upon the surface of the body and communicates with any deeper structure, and which shows little or no tendency to heal.

In practice, however, the terms are used loosely. For instance, one speaks of "fistula of the wither" or of "fistula of the anus," when in reality there is no communication with the rectum or vagina. Similarly, we often hear of "presternal" fistula, "pre-auricular" fistula, and many others.

In any case it is only a question of phraseology, and has no practical bearing on the line of treatment to be adopted, which, after all, is what really matters.

Both fistula and sinus may be considered as a type of ulcer, in which healing is prevented by the passage of irritants, either chemical, bacterial, or both, along its track.

In the case of a fistula, the irritant substance may be a natural secretion or excretion, as saliva, urine, or fæces, whereas in a sinus the offending material is usually pus. Practically all cases of sinus are preceded by abscess-formation.

The chief factors which retard natural healing of a sinus are briefly as follows:

1. The presence at the depth of the track of necrosed tissues or a foreign body.

The former may still be adherent or may be detached "sequestra" which from their size or situation are incapable of being discharged.

Foreign bodies may be represented by pieces of wire, nails, needles, stones, bullets or pieces of projectile, overlooked dressings, such as plugs of wool, and various other articles. The term should also be extended to cover abnormal developments, as odontomata and various types of cyst, and also portions of fractured bone which have become detached.

The tissues which most frequently undergo necrosis as the result of infection or injury are bone, fascia, cartilage, ligamentous and tendinous structures, and muscle.

2. Thickening of the walls of the sinus by the deposition of a layer of inspissated pus and cell débris. This effectually prevents the passage of opsonin-bearing lymph into the cavity, and also hinders the formation of granulation tissue.

3. The situation of the fistula or sinus or the narrowness of its channel, which prevents efficient drainage.

Poll-evil and fistulous withers are instances in which gravitation tends to keep the wound filled with pus, and favours further infection and the so-called "burrowing of pus."

A deeply situated, thick-walled abscess such as may occur in the abdominal wall will provide an almost continuous flow of pus through a very narrow opening.

4. The constant passage of infected material, such as saliva or fæces, along the course of a fistula.

5. Infection of the wound by species of micro-organisms to which the natural resistance is abnormally low, or by a very virulent specific infection.

It must be also remembered that neglect on the part of the owner or surgeon quickly produces a thick-walled, suppurating cavity, the depths of which are deprived of oxygen and light and are maintained at a temperature suitable for bacterial development. An old-standing fistula is always surrounded by tissues possessing low vitality and greatly impaired powers of resistance.

The **treatment** of both sinus and fistula depends upon removal of the cause.

The aim of the surgeon should be briefly—

1. To remove necrotic tissues or foreign bodies at the depth of the sinus.
2. To remove the layer of inspissated pus which lines the channel, and to prevent a further deposit.
3. To increase the natural resistance to the growth of organisms.
4. To maintain efficient drainage.

The surgical removal of necrotic tissues requires a considerable degree of skill. It must be in every way complete, and should err on the side of thoroughness even at the risk of making inroads into sound tissue. This applies especially to soft structures, but a few words of special warning are necessary as regards bone and cartilage. Never remove diseased bone to such an extent as to expose the medullary cavity if it can be avoided. Curetting is far preferable. Never remove a portion of a diseased cartilage if there is any prospect of recovery occurring without the operation; and if it be thought necessary to interfere, excise the whole of the cartilage whether infected or not. A "sliced" piece of cartilage almost always becomes necrotic.

The lining of the sinus track can be removed by caustics, the actual cautery, or the curette. The latter is preferable, as it does not necessitate weakening of the local defences. The further deposit may be avoided by the administration of citric acid in balls, and by irrigation with an alkaline solution of sodium citrate, alternated with very slightly hypertonic solution of common salt. Efficient drainage also tends to prevent the deposit, while stasis of pus favours it.

The natural resistance to the growth of the organisms contained in the sinus may be best increased by the administration of an autogenous vaccine in suitable dosage. Good feeding and the administration of hæmotinics and general tonics in cases associated with debility is beneficial.

Nevertheless, in the majority of instances the administration of vaccines is not essential, provided that the case is treated on sound general principles; but in a few protracted cases bacteriological investigation has revealed the fact that, whilst the natural defences are able in the ordinary course of events to cope with the common pyogenic organisms, the presence of certain other bacteria produces a lowering of the opsonic index for these. Vaccine administration, in nearly every case, overcomes this condition.

Drainage is probably of greater importance than any of the preceding considerations.

To provide an efficient exit for the escape of pus demands a great deal of ingenuity combined with a knowledge of anatomy.

Although we have previously discussed several types of sinus and fistula as the occasion has arisen, we shall next direct our attention to three common surgical affections associated with sinus-formation—namely, poll-evil, fistula of the withers, and quittor.

INFLAMMATION OF THE BURSA OF THE LIGAMENTUM NUCHÆ: POLL-EVIL.

The condition commonly referred to as poll-evil originates from inflammation of the bursa of the ligamentum nuchæ, with extravasation of fluid into the cavity.

The condition may be unilateral or bilateral. Bursitis resulting from external violence is at first non-septic, but the blood or serum which distends the cavity becomes in many cases infected at a later date.

Punctured wounds of the bursa may produce a primary septic bursitis.

A condition simulating poll-evil, but not necessarily associated with changes in the bursa, is occasionally seen in horses and frequently in high mules. It is dependent upon comminuted fracture of a portion of the occipital crest in the neighbourhood of the insertion of the tendinous portion of the ligamentum nuchæ. The external signs are swelling between the ears and a persistent discharge of pus, and frequently sinuses pass beneath the skin of the forehead overlying the temporal muscles. This condition is very amenable to treatment, and recovery usually occurs rapidly after free incision and removal of the detached portions of bone.

The structures which may become affected in a typical case of poll-evil are as follows:

1. The lining and walls of the bursa itself. In cases brought in for treatment soon after the onset of symptoms, the infection may be confined to this region.

We are presuming that an abscess has formed in the bursa, and has either broken naturally or been opened surgically. A considerable amount of pus constantly discharges through the wound in most cases. A thick, creamy pus exuding in moderate quantity is a good indication, but in many instances the discharge is thin and oily-looking and possesses an offensive odour. This condition points to virulent infection or lack of resistance to the organisms present, and is a grave omen.

In long-standing chronic cases of closed bursitis the cavity, upon being opened, may be found to contain masses of corpora oryzoidea.

The lining of the bursa in cases examined post mortem is thickened, dark, almost black or greyish in colour, and frequently thickly coated in parts with inspissated pus. Ulceration and loss of the secretory membrane is not uncommon.

Upon examination, one wonders how it is possible to effect healing without first destroying the lining of the bursa completely and providing a fresh granulating surface, so unhealthy is its appearance.

2. The ligamentum nuchæ is infected and more or less necrotic in parts in quite 25 per cent. of cases. Usually the changes are confined to a few fibres of the surface of the funicular portion, where they come into apposition with the walls of the bursa. Sometimes, however, the amount of destruction may be very great, and ossifying necrosis is not very uncommon.

In thirty cases treated in hospital during the past six months, necrotic changes were evident in the ligamentum nuchæ in seven cases, whilst portions of necrotic bone were removed in six. One case was complicated by suppurative cellulitis of the cervical region which persisted for several months. The remaining cases were apparently pure cases of bursal infection. However, necrosis is difficult to detect within an area which can seldom be examined otherwise than by the sense of touch, and possibly other cases may have occurred, their recovery being facilitated by drainage alone.

3. The occipital bone, wing of the atlas, and ridge of the axis, may undergo necrotic changes, or in the case of the former may be fractured by falls or blows.

4. The occipito-atlantoid ligament may become infected, with perforation of the spinal canal and death. We have observed nervous disturbance in an acute case of bilateral bursal abscess before operation, depending upon pressure. We have only on one occasion met with perforation of the canal.

5. The fascia and muscular tissue of the poll and neck may become infected, with the formation of secondary abscesses in the subcutaneous or intermuscular tissues. These usually discharge their contents some way down the neck, and result in fresh sinus-formation. Small local abscesses often develop in the subcutaneous tissues of the poll, and cause little trouble.

Treatment.—There are two methods of operation in vogue. The first and most commonly practised is incision into the bursa along the mane on one or both sides, according to the requirements of the case. The second method, which in our hands has given by far the better results, with by far the least demand for laborious after-treatment, consists of longitudinal incision into the bursa through the median line of the mane. By the first method the incision extends from the most posterior point of the swelling close along the side of the mane, and is carried as far forward as possible, so that drainage takes place over the forehead. The more anterior the incision is, the more likely is the discharge to escape. The knife should penetrate the bursa, and should expose it through its whole length. Should hæmorrhage prove excessive, the wound may be flushed out with normal saline, plugged tightly with wool, and sutured. Twelve hours afterwards the sutures may be removed. The smell of the plugs should then afford some indication as to the probable extent of the disease. When bone is involved, the typical offensive carious odour will be observed. Necrosis produces a very offensive smell, whereas a comparatively " healthy " sinus has a peculiar and very characteristic sour odour. The base of the wound should then be carefully probed, in order to detect any sinuses running down to the bone or ligaments. If these should be present, they should be opened up as far as possible without risk of injury to the spinal canal.

Part of the funicular portion of the ligamentum nuchæ will probably have been exposed during the operation, and must be carefully examined for necrosis. The curette should be freely used if necessary. Loose pieces of bone may be sometimes felt at this stage of the operation, and should be removed and any exposed surfaces curetted. Care must be taken of the occipito-atlantoid ligament, which may, however, be itself the subject of necrosis. In this case infection will extend to the spinal canal, and will effectually put an end to surgical treatment. Such cases are, however, fortunately rare. The crest of the occiput should be carefully palpated through the skin. We have recollections of a case of poll-evil which resisted treatment for some time until a small fragment of bone was removed from the crest of the occiput, after which healing rapidly took place.

It is advisable to attempt, as well as one may be able, to disinfect the cavity. Although, as before stated, it is impossible under the existing conditions to obtain or maintain anything approaching asepsis, some improvement may be effected by the use of caustic agents, which will remove a layer of the inside of the cavity and at the same time destroy the organisms contained within it. For this purpose we use either nitrate of silver or a paste composed of equal parts of plumbi acetas and zinci sulph. prepared by rubbing the two ingredients together in a mortar. The nitrate of silver may be injected in concentrated solution or applied in stick form to every part of the wound. If preferred, the paste may be used smeared on plugs of wool, sufficient to fill the cavity. As this preparation is a very powerful caustic, it is advisable to remove the plugs in from one to four hours and rinse the wound out.

After-treatment consists in the injection of normal saline solution or Lematte's Solution B (see p. 35), followed by tight plugging with wool saturated in the solution. This should be done twice daily, and persisted in until the fine sloughs have all come away and a clean wound has been produced.

Counter-openings may be made at the lowest part of the wound to assist drainage, if required. Drainage-tubes may be inserted with advantage.

Should it be subsequently found that necrotic changes are still taking place, the cavity should be dressed once daily with zinc chloride or a mixture of turpentine and olive oil (1-4).

It will be found necessary from time to time to enlarge the incision, in order to prevent its closing until the whole cavity is filled with granulation tissue, and to this end careful plugging is essential.

As soon as granulation commences at the bottom of the wound, saline solution and plugging will be sufficient, with a mild application of nitrate of silver or recourse to the oil and turpentine whenever granulation seems tardy or the walls show a smooth, hard lining.

PLATE VIII.

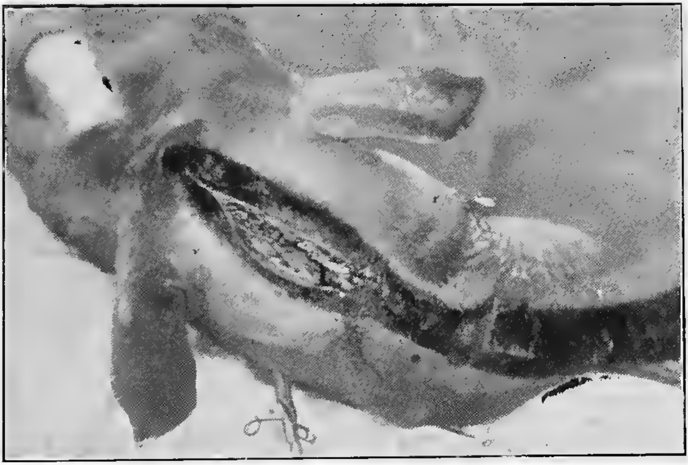


FIG. 22.—Operation for poll-evil by median incision.

To face page 144.

Should this latter condition become insistent, curettage is called for, and should be followed by daily application of sodium citrate solution combined with internal administration of citric acid.

Plugs of boiled tow, sprinkled with salt, may be inserted occasionally, and have a decided cleansing effect.

The second method of operation, which has given excellent results in our hands, is as follows:

The mane is clipped off and the region of the poll shaved.

An incision is then made longitudinally through the centre of the mane, extending from the posterior part of the swelling to the occipital crest (about 4 or 5 inches). The incision is carried through the fibrous tissue underlying the mane until it attains a depth of about 2 inches, when by inserting the finger the funicular portion of the ligamentum nuchæ can be plainly felt as a thick rope-like cord. A long-pointed bistoury is then inserted into the wound in a direction transverse to the direction of the incision. The point of the bistoury is then brought to rest upon the top of the ligamentum nuchæ, and the head being extended, it is inserted by means of a sharp push into the bursa. The finger may now be introduced into the cavity, and can guide the bistoury until the bursa has been opened throughout its entire length. When the condition is bilateral, the other bursa is opened in a similar manner.

Should there be an external wound on the side of the neck communicating with the bursa, a stout probe may be inserted into this, and will serve to locate its position when the finger is introduced into the incision; but after a little practice there is no difficulty in determining this without the assistance of a probe.

The advantages of this method are that a clean wound is produced more or less out of sight, little after-treatment is required, and healing is rapid. Unless serious bone lesions exist, the time required for recovery occupies a matter of six or eight weeks only, whereas by the former method treatment in our hands has always extended over several months.

No plugging is required and very little dressing beyond washing, although we have sometimes found it beneficial to inject the bursa with concentrated silver nitrate solution immediately after operation.

The chief point that requires attention is that the wound has a tendency to heal externally too rapidly, and the finger should be inserted into the bursa through the external wound once every few days.

Feeding the animal off the ground favours drainage during the first week after operation, but beyond that time we are of opinion that it is certainly not beneficial.

In a few cases, which have been in existence for some time previously to operation, we have found it advantageous to insert a perforated drainage-tube through a counter-opening at the lowest point of the bursa and to keep it in position by transfixing it outside the middle-line incision with a stout piece of wire the ends of which are curled upon themselves. This assists drainage and ensures the opening into the bursa remaining patent. We have never found occasion to practise resection of the ligamentum nuchæ, as described by so many authors.

After either operation, hard fibrous swelling may persist or even increase. This is usually an indication that a small abscess exists some distance beneath the skin, and as the local circulation is poor in this region, it tends to remain in a position of stasis. A biniodide blister rubbed into the swelling usually causes an outpouring of lymph and corpuscles into the infected area, with the result that the abscess enlarges and either bursts naturally or can be opened. The swelling then subsides. Counter-irritation also has a very beneficial

PLATE IX.

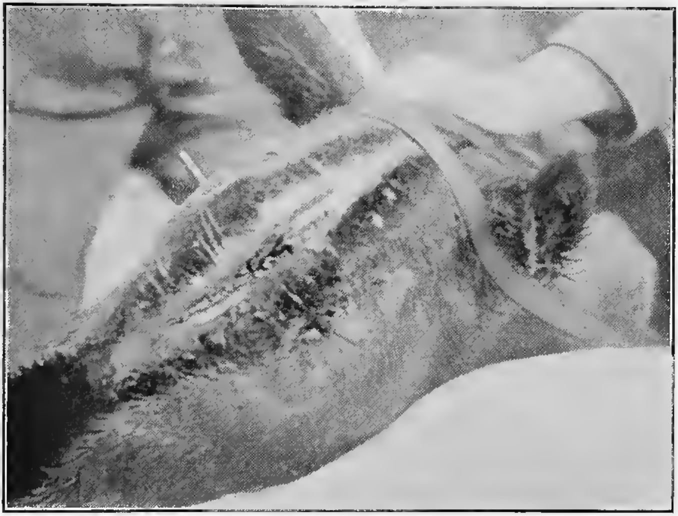


FIG. 23.—Poll-evil, three weeks after operation, healing nearly complete. Drainage-tubes in position.

To face page 146.

effect on all cases of fistula in which healing is retarded and granulation appears weak. Chronic fibrous thickening, persisting after healing of the wound and which shows no tendency to suppuration, may sometimes be diminished by repeated blistering, but we have obtained the best results by the local injection of a thiosinamin preparation, such as fibrolysin or sclerosin. If these are unobtainable, concentrated solution of common salt may be used. The result of this treatment, in our experience, is to produce a local abscess, with breaking down of the inflammatory fibrous tissue and a diminution in the size of the swelling as a sequel. The injection should not be made too deeply, but about ½ inch below the surface of the skin.

Cases of poll-evil may resist treatment for several reasons. In the first place, bone lesions or necrosis of the ligamentum nuchæ or the ligaments between the bones may remain undetected.

If the surgeon is quite satisfied regarding these points, the most advisable proceeding is to make a thorough bacteriological examination of the pus, and to prepare an autogenous vaccine from the cultures. It will frequently be found that one particular type of organism preponderates after the practical disappearance of others, and the lack of resistance thereto on the part of the patient accounts for the delay in healing. Nevertheless, no vaccine, autogenous or otherwise, will assist healing whilst sloughs, necrotic ligament, or diseased bone, remain in the wound. They are certainly of assistance under those conditions in which drainage is unsatisfactory and when particularly virulent types of organism are present, or when the opsonic index is low for the common pyogenic organisms.

We strongly advocate intramuscular injection of nuclein in conjunction with the administration of vaccines.

Horses affected with poll-evil should always be housed. Those which have recovered from the disease and are turned out to graze are very liable to a recurrence of the condition, even after several years.

FISTULA OF THE WITHERS.

The structures which may become involved in this condition are very numerous. They are as follows:

1. Skin and subcutaneous tissue.
2. Fascia of the withers.
3. Ligamentum nuchæ and the bursa mucosa at the base of the neck.
4. Superior spinous processes of the dorsal vertebræ and the supraspinous ligament.
5. The cartilage of prolongation of the scapula, and in some cases the scapula itself.
6. Muscle and intermuscular connective tissue.

Seeing that the causes of this condition are so numerous and varied, it would be idle to lay down any definite line of treatment which would be applicable to every case.

The most important points to attend to are removal of necrotic tissue and the provision of drainage. The latter is more easy of accomplishment than in the case of poll-evil, as we can make counter-openings at various parts of the withers and shoulder. The removal of necrotic tissue is often a difficult matter, and even when this can be satisfactorily performed necrotic changes are very apt to extend into the previously sound tissue, especially in the case of the spinous processes and that of the cartilage of prolongation of the scapula.

Very many cases, however, especially when seen early, depend upon infection of the mucous bursa at the base of the neck. This is the most favourable situation. But in a large number of instances direct bruising of the spines, with secondary infection, has produced necrotic changes in the supraspinous ligament. summits of the bones, and the terminal portion of the ligamentum nuchæ. The prognosis must then be very grave.

There are two methods, either of which we may adopt in order to obtain drainage. The first and most generally practised is as follows: A long probe is inserted into each sinus (should more than one be present). As these usually take a downward course, it follows that the point of the probe must be below the level of the sinus opening. Just below this spot a small vertical incision is made in the skin, and is carried through the fascia and muscle until it meets the probe. A tape may then be carried through the sinus, and the ends brought out at both openings and knotted together. A drainage-tube may be used, if preferred. It must always be borne in mind when probing a fistula that the probe meets with but little resistance when inserted into connective tissue underlying the skin or between muscles, and it is a very easy matter to mistake the direction of the sinus, especially when it is tortuous or when it branches off at an angle, and to push the probe through sound tissue.

The second method is to insert a long probe-pointed bistoury to the depth of each sinus, and to incise it in a vertical direction throughout its length. This method certainly gives better drainage, but it is usually followed by turning-in of the edges of the skin, and a certain degree of deformity exists after healing is complete. This can be avoided to a certain extent by excising elliptical pieces of skin from either side of the incision, and trusting to the contraction of the resulting scar to straighten the edges of the wound. This method certainly affords a far better opportunity of removing necrotic fascia or ligamentum nuchæ than does the former, and in spite of its minor disadvantages, it is the one we prefer.

Should, however, the sinus lead towards the summit of the dorsal spines, it is better to ignore it altogether and to make a longitudinal incision along the middle line of, or slightly on one side of, the withers. By this means the affected region can be palpated, and roughened necrotic bone, if present, can be felt with the finger. It must be borne in mind that necrosis is seldom confined to one spinous process, and the neighbouring summit on either side should be carefully examined. H. E. Bemis, writing in the *Journ. Amer. Vet. Med. Assoc.*, December 15, 1916, recommends a triangular incision, with the base of the triangle uppermost, 3 or 4 inches from the top of the neck and 2 to 4 inches in length. The apex of the triangle should be slightly below the lower border of the rhomboideus muscle, so that the sides of the triangle may be 5 or 6 inches in length. The incision passes through the skin, trapezius, and superficial fascia. When the triangle is removed the rhomboideus is exposed. The operator can now work over the superior border of the rhomboideus into the cavity to trace the fistulous tracts, remove necrotic ligament, and determine the depth of the process. If there is extensive swelling and necrosis, an incision may also be made exactly on the median line, and tissue removed through both openings.

Removal of the affected spinous processes can be effected by means of the bone-saw, but is seldom attended by success, owing to extension of the necrosis to the fresh divided surface. The only means of avoiding this is very frequent irrigation of the parts, after operation, with the hose-pipe. We have had some degree of success by this method, but the proceeding demands a great deal of the time of the attendant. From four to six applications, extending over at least half an hour, are necessary daily. We have had excellent results from continuous irrigation by means of the apparatus depicted in Fig. 33. Weak solutions of permanganate of potash alternating with normal saline are very suitable. As little as possible should be removed from the dorsal spines, and the soft centre of the bone should not be penetrated if it can possibly be avoided. Curettage is often sufficient, and should be followed by the application of a strong solution of iodine, and after-treatment by means of cold irrigation.

The cartilage of prolongation of the scapula is sometimes affected. The most common lesion in our experience is a perforating wound with necrotic edges, probably the result of a previous puncture. This condition is frequently complicated by suppuration in the connective tissue at the back of the scapula and abscess-formation under the arm or at the shoulder. Necrosis of the cartilage is seldom worth treatment. When the upper edge is affected, paring with the scalpel only aggravates the condition. The cartilage of prolongation is made up of two distinct flat halves, united by a small amount of fibrous tissue. Any breach of the continuity of the cartilage permits of the passage of bacteria into this layer, with fresh sinus-formation in its substance and an extension of necrosis. The scapula itself may become involved in the process, and we have seen specimens upon post-mortem which appeared as though they had been drilled through. The soft centres of these were also traversed by long, narrow sinuses.

Total removal of the affected cartilage is the only method likely to prove successful.

Portal's method was to excise the whole through a V-shaped incision, the angle of the V being uppermost. He included the upper edge of the scapula. The drawback is the time required for healing, which often renders treatment unprofitable. Nevertheless, success is not likely to be attained by any other means.

Suppuration, extending below the elbow or into the shoulder region, must be treated by free drainage. Trephining the scapula has been recommended, but is open to grave objection on the ground that it favours the production of necrosis in the centre of the bone.

Cold water, in sufficient quantity, is undoubtedly the best application for the after-treatment of fistula of the withers.

Oil and turpentine, or astringents, as white lotion, or Villate's solution, may be useful, but, together with numerous other preparations, they are of minor importance when compared with good drainage and appropriate surgical treatment.

QUITTOR.

The term "quittor" is applied to sinus-formation in the region of the coronet dependent upon necrosis of the lateral cartilage of the pedal bone.

Unfortunately, the same word has been often used to describe sinuses occurring in the same region which have no connection with the cartilage, and thus a good deal of confusion, arises. Quittor must be distinguished from "false quittor," "coronary fistula," or "cutaneous fistula," which involves only the subcutaneous or subcoronary tissues, and in some cases the plantar cushion and sensitive laminæ.

Neglected "false quittor" in many cases eventually leads to infection of the parachondrium (the connective tissue surrounding the lateral cartilage), with extension to, and finally necrosis of, the cartilage. The actual infection may originate at various points. Treads of the coronet may produce necrosis of the subcoronary con-

PLATE X.

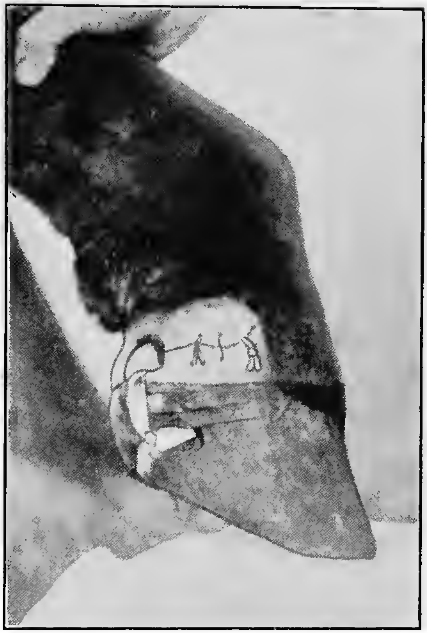


FIG. 24.—Quittor. Operation above the coronary band, with drainage below. Five days after operation.

To face page 152.

nective tissue, coronary band, or sensitive laminæ. Suppurating corns may introduce infective material into the plantar cushion, from whence it may extend to the parachondrium, which is really an extension of this structure, or may produce secondary infection of the sensitive laminæ of the sole wall or bars, with extension to the coronet region.

In addition to the lateral cartilage and the structures noted above, necrosis may involve the pedal bone and its ligaments and the synovial capsule of the joint where it lies beneath the anterior portion of the cartilage. We have often observed that quittor-formation may be dependent upon fracture of an ossified or partially ossified lateral cartilage. In several cases in Shire horses occurring in the forefeet and in one case in a riding-horse we have removed portions of bone, which could be traced to the upper border of a "side-bone." Sometimes four of five fragments, each of the size of a pea, may be detached.

In two cases occurring in heavy horses, post-mortem showed necrosis of the upper border of the "side-bone," and in one instance the rough edge of the bone could be distinctly seen through a large sinus existing at the bulb of the heel. We are of opinion that the extension of necrosis from a diseased cartilage to an "incipient" side-bone is frequently the cause of protracted cases which do not yield to operative measures.

The lateral cartilage is not of one structure throughout. The posterior portion is composed of small islets of cartilage bound together by connective tissue, whereas the anterior portion is composed of solid cartilage and, moreover, affords protection to the synovial cul de sac of the coffin joint which lies directly beneath it. Quittor occurring in the region of the heel is therefore more amenable to simple treatment, as sloughing out of affected portions of cartilage is easier and there is not the same risk of injury to the joint capsule. Also, quittor-formation at the outside of the coronet is not exposed to treads from the opposite foot.

Necrosis of the cartilage is not so common as is generally supposed. Probably 75 per cent. of cases of sinus-formation in the coronary region, at the time when the veterinary surgeon is first consulted, are cases of "coronary fistula" without complication.

Moreover, necrosis, when present in the cartilage, is not usually widespread, but is confined to small areas, although we believe that bacterial infection may exist in the surrounding portions of apparently healthy cartilage, as is exemplified by the ease with which necrosis occurs in any portion inadvertently left behind after operation. Usually a sinus traverses the cartilage, either passing through it from side to side or obliquely downwards and forwards through its thickness. The necrotic portions of cartilage are usually of a dirty green colour, and fragments may be present in the sinus. In our experience, at least, it is very uncommon to find large areas of necrotic cartilage, as described in many textbooks.

Treatment.

In spite of the many and varied methods of treatment described in textbooks and by independent observers, true quittor still remains one of the most unsatisfactory conditions which the practitioner is ever called upon to treat.

We do not propose to describe in detail the technique of the various operations, which will be found fully described in most textbooks on surgery, but to briefly relate the points in favour of or against each method.

1. *The "Standard" Operation.*—Removal of the lateral cartilage from below the coronary band.

PLATE XI.

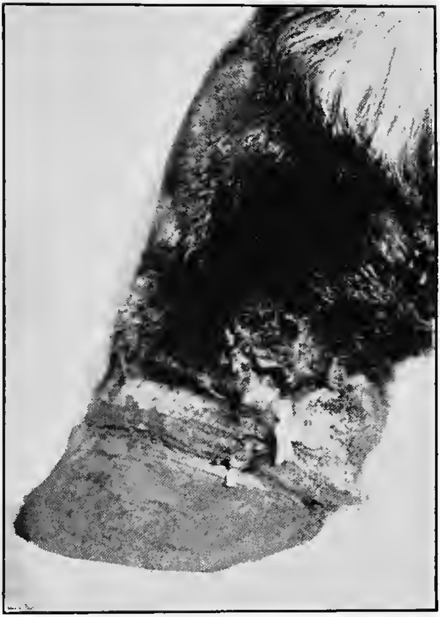


FIG. 25.—Quittor. A similar case, ten days after operation.

To face page 154.

We have treated a large number of cases by this method, and can find very little to recommend it.

The actual operation itself is difficult to accomplish, and complete extirpation of the cartilage, particularly as regards the anterior and upper portions, is practically impossible. This is a *sine qua non*, and the anterior corner of the cartilage is the part from which secondary abscess-formation most often occurs.

Even provided that the whole of the cartilage is removed without injury to the synovial capsule of the coffin joint, very careful attention has to be paid to subsequent dressing, as granulations close the opening under the coronary band in the course of a few days and pocketing of pus occurs, which again breaks out at the coronet. We have found a stiff, short piece of drainage-tubing useful to counteract this.

Lameness is often persistent, and in any case several months are necessary in which to replace the horn over the seat of operation. Frequently the coronary band in that region becomes swollen and deformed, and the resulting growth of horn does not remain in continuity with that of the quarter, and so overlapping results. In the majority of successful cases false quarter or some deformity of the hoof persists after recovery.

2. *Bayer's Operation.*—As this is dependent for success upon complete asepsis both at the time of operation and afterwards during the healing process, it is unsuitable to veterinary practice. Owing to the situation of the foot, bandages become soiled with urine and fæces, and the wound must of necessity, in most cases, be left at the mercy of unskilled dressers. It has also the disadvantages dependent upon section of the coronary band.

3. *Perrier's Operation.*—Removal of the entire lateral cartilage through a crescent-shaped aperture above the coronary band.

This is, in our opinion, the most practical of any of the described "extirpation" operations. It has the disadvantage that a pocket is produced, which is contrary to surgical principles, but this may be overcome by drilling a hole through the wall at the lowest point of the cavity and keeping it open by means of a seton or drainage-tubing.

4. *Schröder's Operation* is similar to Bayer's, excepting that the convexity of the incision is posteriorly situated instead of inferiorly. It is open to the same objections, and is not well commented upon, although we have no personal experience of the operation.

5. *The Actual Cautery and Various Caustic Agents.*—We have had a number of successful results from the insertion of a miniature budding iron, heated to redness, through the sinus, and brought through an aperture in the horn of the wall, which had previously been thinned out with a drawing-knife.

We insert a tape seton through the tract and tie both ends. Copper oleate ointment should be smeared on the tape daily, after soaking in a hot foot bath containing cupri sulph. and alum, of each 1 ounce to the gallon. A saturated solution of iodoform in eucalyptus oil is also a good application.

This method is only applicable to quittor occurring in the region of the heel. It would be unwise to insert a cautery into the front of the cartilage, owing to the proximity of the synovial membrane.

We do not advocate the insertion of caustic dressings, either on the score of practice or theory. Their action is too uncertain.

The actual cautery should be tried in all cases of posterior quittor before resorting to operative measures.

We never perform an operation for quittor whilst lameness and inflammatory phenomena are marked.

PLATE XII.

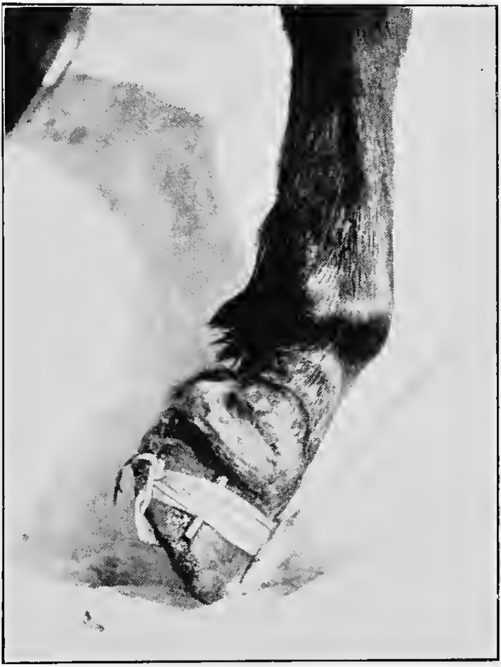


FIG. 26.—Quittor. Two weeks after operation. Drainage by means of a metal tube.

To face page 156.

The method with which we have had most success is as follows:

A straight or curved incision is made, according to circumstances, through the skin and subcutaneous tissues of the coronet.

The straight incision commences at the upper and posterior edge of the cartilage, and is carried downwards and forwards to its anterior insertion. The curved incision has its convexity close to the coronary band. The cartilage is removed after freeing it from surrounding tissues by means of the double-edged curved knife. It is then extracted in two portions, with the foot well extended, by means of the right and left handed sage knives, as in Perrier's operation. No difficulty is experienced in reaching every part. After removal of the cartilage, a hole ¾ inch in diameter is drilled through the wall covering the deepest part of the cavity in the region of the heel. The whole of the wound is then washed with weak iodine solution. Three or four deep sutures of waxed silk are then inserted through the two flaps of skin until the edges are brought into close apposition.

A bandage is now applied over the coronet wound over a thick layer of boric wool. The cavity is then packed with gauze through the drainage-hole in the hoof. A temporary bandage may be applied over this if bleeding is excessive.

The gauze is changed daily, and the wound is injected with weak iodine solution through the drainage aperture, but the coronary bandage should not be removed, unless saturated with discharge, for at least ten days.

Provided that the whole of the cartilage is removed without injury to the synovial capsule, and that drainage is maintained throughout, healing should be complete in six weeks.

We have had a number of recoveries in four weeks, when the necrosis has been confined to the posterior portion of the cartilage. Out of about thirty cases treated by this method, two were destroyed as a result of injury to the joint capsule, one died from septic coronitis from infection, two showed no improvement, probably as a result of incomplete removal of the cartilage, and the remainder recovered after periods ranging from four to fourteen weeks.

Lameness persisted to a slight extent in four.

We believe that the most common cause of lameness following "excision" operations is neuroma of the posterior branch of the plantar nerve, which is cut in the process of freeing the cartilage from the surrounding connective tissue.

M. Hamoir states* that the cartilage becomes rapidly reconstituted after operation, and ossified. Lesions of the osseous tissue extend to the os pedis and even to the navicular bone.

We have examined three feet which had been operated upon nearly a year beforehand, and fibro-cartilage was certainly present in the situation usually occupied by the lateral cartilage, but whether the whole of the cartilage had been removed at the time of excision is uncertain. Possibly the operator had only "shaved" the cartilage to remove necrotic tissue.

Cases of "false quittor" are best treated by curettage, followed by a linseed-meal poultice, the surface of which has been lightly smeared with biniodide of mercury ointment, 1-12. The poultice should be left in position for three days, after which astringent injections and foot baths will usually be sufficient. When the condition is dependent upon pus-formation within the foot, drainage from the sole is, of course, essential to success.

---

* See *Veterinary News*, June 23, 1917, "The Treatment of Necrosis of the Lateral Cartilage," translated by E. Wallis Hoare, F.R.C.V.S.

PLATE XIII.

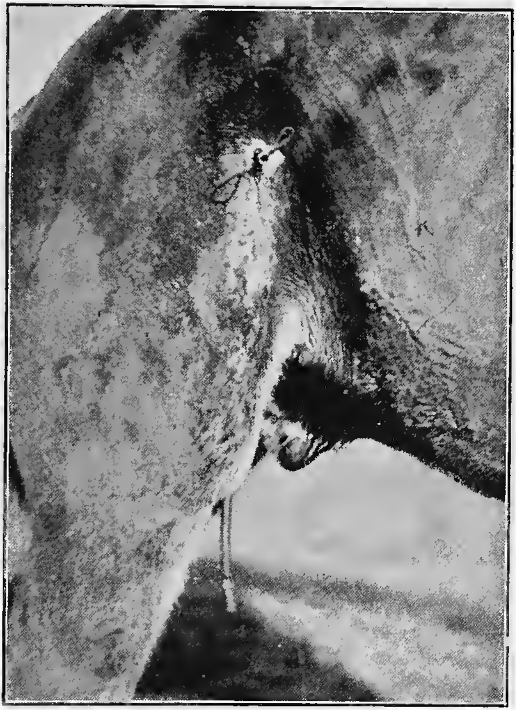


FIG. 27.—Abscess of abdominal muscles. The abscess cavity, with its thickened walls, has been removed through the almost healed incision visible at the top, with end of drainage-tube emerging. The lower end of tube indicates the original opening of the fistula on the inner side of stifle.

To face page 158.

FISTULA OF THE INGUINAL REGION.

This condition may persist from the time of castration or may occur a considerable while after healing of the original wound is complete. In most cases the fistula results from infection of the divided end of the spermatic cord (scirrhous cord). Bothryomyces are nearly always present in the pus cavities, together with a variety of pyogenic organisms.

Scirrhous cord commonly evidences itself within a few months of castration, but instances have been recorded of cases occurring after a number of years. We have ourselves observed the condition in an American-bred mule over twenty years of age. This animal had probably been castrated as a foal, and at the time our attention was drawn to the case it had been in the possession of the owner for many years, during which it had shown no symptoms of the condition.

It must, however, be borne in mind that all cases of fistula occurring in the inguinal region do not necessarily involve the spermatic cord. We have on several occasions observed large tumour-like formations in the groin, complicated with the presence of a fistula, which, upon operation, proved to be masses of chronic indurated lymphatic glands. No other lesions were present. Glanders, actinomycosis, bothryomycosis, or chronic infections of the penis, scrotum, prepuce, or neighbouring skin, might account for such a formation, but in the above cases glanders was negatived by absence of reaction to mallein.

Occasionally, as before mentioned, an abscess cavity in or between the muscles of the abdominal wall may produce a discharge of pus from the inguinal region. Usually in this case a probe may be inserted for a considerable distance, but it is possible to traverse the connective tissue between the limb and the abdominal wall in the belief that the probe is following the course of the sinus. If the abscess can be located, treatment is often a comparatively simple matter.

There is usually a far greater quantity of pus discharged from an abdominal abscess than from a scirrhous cord, and in the former case particularly exercise greatly increases the flow. The discharge of pus from the latter is usually of an intermittent character, and may be only observed at intervals.

Occasionally a small, shallow sinus persists after castration, but discharges little or no pus. It is usually accompanied by some thickening of the subcutaneous connective tissue of the prepuce, and the condition appears to be confined to that neighbourhood. Possibly local infection occurring during the later stages of healing is responsible. We have not observed lesions of the spermatic cord accompanying this condition.

Anal Fistula.

This expression signifies any fistula having an external opening in the region of the anus. One which communicates with natural passages, as the rectum or vagina, is usually termed a "complete fistula," whilst one which terminates in the paraproctal connective tissue or otherwise ends blindly is termed "incomplete fistula." On some occasions the fistula eventually communicates with the peritoneal cavity, with peritonitis and death as a sequel.

Incomplete Anal Fistula is in our experience far the more common condition, and mules seem especially predisposed, although we have met with several cases among horses. The cause of the fistula is often obscure; doubtlessly cellulitis and infection of the paraproctal connective tissue is usually the starting-point. Wounds

PLATE XIV.

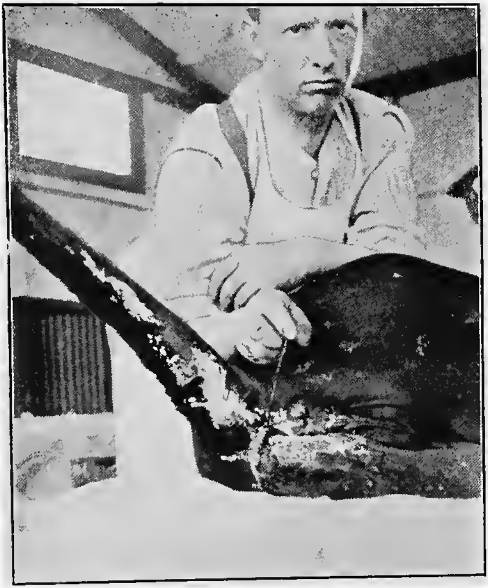


FIG. 28.—Anal fistula in a mule.

To face page 160.

PLATE XV.

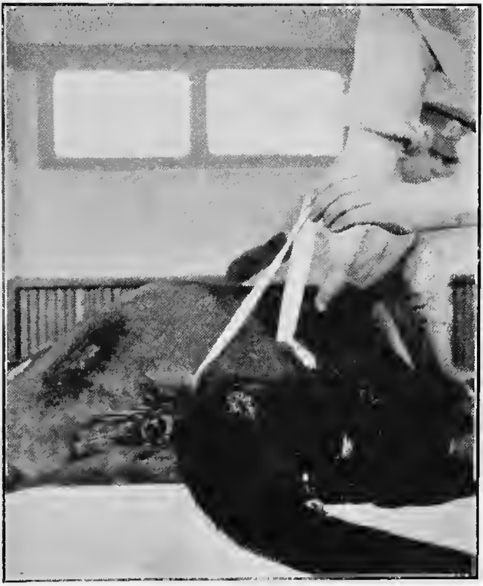


FIG. 29.—Method adopted to provide drainage.

of the rectum, heavy falls or blows, may produce infection and necrosis; probably strangles infection may be responsible for some cases. The thinly clad, sloping quarters of mules are particularly liable to external injury, especially from kicks, whilst lying in the lines.

The fistula may open anywhere close to the anus, this being the line of least resistance, but the majority occur in mules at the side and in horses above, just under the root of the tail. In the latter case there is resistance to the exit of pus, owing to pressure from the dock, and swellings usually occur on either side of the rump, close alongside of the coccygeal vertebræ, and eventually break and discharge pus in that region.

In those cases in which the opening is at one side of the anus, the fistula usually penetrates the muscles and extends as far as the sacro-sciatic ligament, which forms the floor of the abscess cavity, and reaches the loose tissue around the innermost extremity of the rectum. The abscess may communicate with the fascia or muscular tissue of the thigh, and cavities may be produced capable of holding several pints of fluid. Sometimes the fascia covering the tibia becomes underrun, and pus may be discharged from just above the hock. Large bloodvessels are occasionally involved and rupture, the animal speedily dying from hæmorrhage.

Treatment is very unsatisfactory in most cases. The injection of antiseptic fluids and the application of caustics is in our experience useless, and attempts to close the external orifice, even if this were possible, would only lead to fresh sinus-formation, as the fistula merely represents an outlet for the pus which has accumulated in the deeply seated abscess cavities.

The only treatment we have found of service is free incision into the abscess cavity from without, cutting through the skin and muscles of the quarter, estimating the point of incision by comparing with the distance to which a probe can be inserted into the fistula. A drainage-tube or tape should then be inserted by means of a long probe carrying a cord, and should emerge through the orifice in the region of the anus. Frequent flushing out of the cavity by means of the hose-pipe gives the best results subsequently.

Whilst operating, or later whilst dressing, great care must be taken of the iliac vessels. We once accidentally injured the external iliac artery, but secured arrest of the hæmorrhage by plugging with gauze. Two days later violent hæmorrhage again broke out, but was controlled in the same manner, and no further bleeding occurred.

Treatment is always prolonged, and is not in every case rewarded by success; and as many animals of little value continue to work satisfactorily for some time, surgical interference should not be decided upon until absolutely necessary. Lameness is seldom present even in advanced cases.

Complete Anal Fistula may communicate with the rectum, vagina, or both.

Rectal fistula is usually treated by incising the walls and providing drainage. Nitrate of silver may be occasionally applied with advantage. In enlarging a rectal fistula care should be taken of the sphincter ani, as division of this structure is not in all cases followed by union.

Some practitioners recommend the insertion of a tape or lead wire through the fistula, the ends being tied outside the anus.

Vaginal fistula is not usually amenable to treatment, unless the vaginal opening be close to the vulva, when suturing may be occasionally successful. The same applies to recto-vaginal fistula.

PLATE XVI.

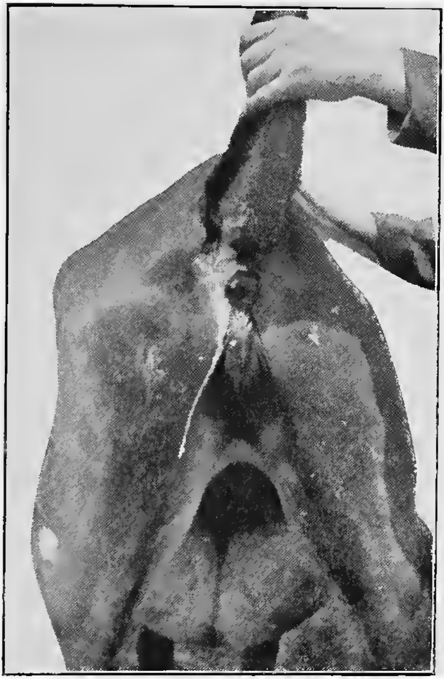


FIG. 30.—Anal fistula in a mule.

To face page 162.

CHAPTER XII

CASTRATION WOUNDS

UNDER the ordinary circumstances associated with the castration of horses infection invariably occurs, even when the operation is performed under conditions as nearly approaching asepsis as possible. It always occurs subsequently to operation, and is unavoidable, as the wounds are necessarily left open and are in an exposed situation.

The organisms responsible are the ordinary pyogenic bacteria, and in some cases *B. coli*, *B. tetani*, and *B. œdematis maligni*. Bothryomyces somewhat frequently gain access to the wound.

Granted that efficient drainage has been provided and subsequently maintained until healing has been completed, the first group seldom set up serious symptoms, excepting, perhaps, mild fever and local swelling and suppuration. *B. coli* is probably the worst offender in cases of peritonitis following the operation. Bothryomyces produce the condition known as "scirrhous cord," but it apparently happens somewhat frequently that these organisms lie latent in the cord or in close proximity to it for a considerable time before setting up the condition. In the majority of cases, however, scirrhous cord develops during the healing process, which is thereby retarded, with the formation of a fistula, the intermittent discharge of pus, and the characteristic tumour-formation.

A moderate degree of swelling, attended by fever ranging from 101° to 103° F., is normal after the operation in a large percentage of cases. Providing that the animal be freely exercised, and that the wounds are of such a nature that there is free exit to pus and absence of "pocketing" or too early external healing, these cases recover, and healing is complete in a fortnight to three weeks.

A certain amount of thickening of the stump of the cord remains for some weeks longer, but does not necessarily indicate infection by bothryomyces.

Premature healing of the external wound usually causes the formation of an abscess. Systemic symptoms may be marked, but in most cases are slight. Free incision of the swelling usually brings about recovery.

A high degree of fever may be associated with entire absence of swelling or a very considerable amount. The latter is by far the more favourable combination; an absence of swelling indicates lack of resistance to the infection. A thin, serous discharge usually accompanies this condition.

Peritonitis is usually ushered in by fever (104° to 107° F.), loss of appetite, disinclination to move, and a general "tucked-up" appearance, with hanging head and frequently intermittent attacks of colic. The respiration is chiefly thoracic, and the muscles of the abdominal region are fixed and tense upon palpation.

The wound in most cases exhibits little or no swelling, although in a small percentage of cases it may be very great and extend even to the sternum. A thin, sanious discharge usually drips from the scrotum. The seventh or eighth day after the operation is the most critical period; most cases of peritonitis develop about this time.

Tetanus may develop at any time after the eighth day, according to whether the infection has occurred at the time of or subsequently to the operation. Following castration it is almost invariably fatal.

The precautions which we may take to prevent unfortunate sequelæ are briefly as follows:

1. Free incision of the scrotum at the time of operation, commencing well at the front of the testicle.

2. Daily exploration of the scrotal wound after the third day with a clean finger whenever possible. This should not be left to attendants if it be possible to do this personally, as their ideas regarding asepsis are usually unorthodox.

A little antiseptic ointment may at the same time be smeared on the thighs and prepuce to keep away flies.

Occasionally, as a result of undue traction being exerted upon the cord, it does not retract into the scrotal wound as it should normally do, owing to rupture or stretching of the muscular fibres. The free end may then become adherent to the edges of the wound and prevent drainage, or even become strangulated. This is the ideal condition for infection by bothryomyces. The external wound should be kept open until healing is complete in the depths.

3. Abundant exercise should be insisted upon to facilitate the escape of discharges and lessen swelling. Old horses are sometimes put to work within a day or two of operation, and we have never observed any untoward results; indeed, apart from the question of cruelty, we are of opinion that it is good treatment. In suitable weather horses should be kept outdoors after operation. A dirty field is usually less septic than a so-called "clean" house. Fields in which pigs or poultry are kept should be avoided. When rain or cold winds (particularly easterly) predominate, animals are better housed and exercised daily.

4. The administration of antitetanic serum at the time of operation.

The treatment of infected castration wounds is confined to the provision of drainage and the application or slow injection of warm antiseptic fluids. Hydrogen peroxide is suitable. Wounds which have closed too rapidly should be reopened and adhesions of the cord broken down with the finger. The cavities should be plugged with cotton-wool soaked in hydrogen peroxide, but the plugs should be renewed every few hours, otherwise they may favour the continuation of infection.

Such medicinal treatment as may be considered necessary may be administered. Vaccines are of little service when high fever is present, and may even do harm. Antiserums and nuclein may be of some use, and phylacogens have been recommended, but we have no experience of their use under these conditions.

CHAPTER XIII

UTERINE AND VAGINAL WOUNDS

These are most frequently the result of injury during parturition or copulation.

In mares and cows the feet of the fœtus may penetrate the walls of the uterus or vagina, or the hocks may do so, particularly during delivery in the case of thigh and croup presentation. Occasionally the feet pass through both vagina and rectum, and may even emerge at the sphincter and inflict severe injuries to the perineal region.

During the last foaling season (1916) we attended a big cart mare in which one forefoot had penetrated both vagina and rectum and emerged at the anus. The efforts of the mare, which was left unattended, effected delivery in this manner, completely dividing the roof of the vagina and the floor of the rectum and the sphincter ani, so that the two passages were confluent for a length of 9 inches. Owing to the nature of the wound suturing was impossible. Treatment was confined to the insertion of antiseptic pessaries with a soft wax base. Union did not occur, and the connection between the rectum and vagina persisted throughout the length of the latter. Probably the division of the sphincter ani was responsible.

Curiously, fæces did not at any time enter the vagina excepting at the entrance of the vulva, the rectum appearing to contract around the masses sufficiently tightly to retain them. Defæcation was performed quite normally. The mare is still working satisfactorily, and appears none the worse for the persisting condition.

Wounds penetrating the wall of the uterus in mares usually terminate in peritonitis and death. This is, however, by no means always the case in cattle, particularly when the wound is not on the floor of the uterus. We have seen a slit about 4 inches in length in the roof of the uterus of a cow, which occurred during parturition, recover without treatment and without causing any ill effects. It is probable that many injuries occur and remain unsuspected when cattle are assisted during parturition by unskilled hands. We believe that irrigation of the wound frequently causes death through the escape of fluid into the peritoneal cavity through undiscovered punctures or tears in the womb.

We once injected 1½ gallons of warm dilute solution of pot. permang. into the uterus of a cow suffering from septic metritis, and being unable to effect the return of the fluid, made a manual examination and discovered a rent in the floor of the uterus through which the injection, and in all probability discharges, had passed into the peritoneal cavity. Violent colic at once ensued. This abated in a few hours, and the animal made a perfect recovery, and has safely calved since. Possibly the antiseptic nature of the fluid saved the animal's life, but in another case of a similar nature which came to our knowledge death occurred a few hours later.

Wounds of the uterus of any considerable size are frequently associated with prolapse of the intestines into the cavity. We have only once seen recovery follow in such circumstances. A Jersey cow had been delivered of a large decomposed calf of several weeks' supergestation. The removal of the fœtus was accomplished by practising embryotomy and forced traction, and occupied several hours. Immediately after the delivery of the last portion a loop of bowel was observed protruding through the vulva. This was traced to a wound of the floor of the uterus close to the os. Antisepsis was out of the question, and the loop was simply replaced and the rent sutured with an ordinary darning-needle and thread, the only appliance available at the moment. The animal was at the time in a very exhausted condition, but her eventual recovery was as complete as it was unexpected. Large wounds in the wall of the uterus, particularly in the region of the floor, are almost invariably fatal.

We were once requested to attend a heifer about to calve, which had been previously "examined" by a local empiric. Not at first feeling the calf, the hand was passed around the womb and a large rent discovered in the roof, as far in as the hand could reach. Emerging from this was one of the hind-feet of the calf. The operator, in his efforts to straighten out what had evidently been a thigh and croup presentation, had pushed the calf forward completely through the womb and into the abdominal cavity, where it was discovered upon post-mortem examination.

It is usually a difficult matter to suture a uterine tear, but we have found the following method practical, although in most cases the peritoneal cavity has become infected at the time of the infliction of the injury.

A fairly large half-curved needle is used. The suture material should be of stout silk, previously waxed or oiled to prevent absorption of fœtid matter from the wound, which would thereby be carried into the peritoneal cavity. Each thread should be at least a yard in length, and should be threaded only a few inches through the eye of the needle.

The needle is carried in the hand through the vagina into the womb, and is inserted deeply through both lips of the wound, so that the serous coats may be brought into contact. The needle and silk are then withdrawn, and one end of the latter is tied into a loop which is passed over the other end to form a slip-knot. Whilst holding and gently pulling the free end, the other hand follows the running knot into the womb until it is drawn tight and the edges of the wound are brought together. The needle is then threaded with a fresh length of silk, and the process is repeated until the rent is completely closed. The several protruding ends of silk are then brought together and twisted until they produce a cord which reaches almost to the wound and assists in keeping the sutures tight. A stitch is then inserted through the skin at the side of the vulva, and the cord is tied to it after being drawn a little taut.

As injections are at all times dangerous, preference must be given to pessaries in the treatment of uterine and vaginal wounds. Boric acid, chinosol or substitutes, or eucalyptus oil, may be embodied in a gelatine and glycerine or soft wax base. Vaseline and hard paraffin wax in equal parts melted together make a soft wax which has also the advantages of being soothing and protective and of melting slowly.

In cattle wounds received during service are not uncommon either in the vagina or uterus, particularly on the roof. As they are frequently quite small, they are often overlooked. Peritonitis is a very common sequel. In mares perforation of the vagina and of the cervix is occasionally observed; in rare cases the vagina and rectum are both injured, particularly when the latter is full of fæces. Recovery may occur in either case, providing that the peritoneum is not involved, as may be the case when the roof of the vagina is the seat of injury.

CHAPTER XIV

WOUNDS INVOLVING BONE TISSUE

COMPOUND FRACTURE.

WOUNDS of this nature (apart from cases of compound fracture) are frequently met with in the mouth as a result of injury to the interdental space by the misuse of the bit. They are also common in other situations, as the poll and withers, in docking wounds, and in wounds of the feet.

Wounds associated with fracture may arise either from injury inflicted at the time of the accident, from subsequent perforation of the skin by sharp broken pieces of bone, as a result of abscess-formation, or by ulceration of the skin in the neighbourhood of the fracture subsequently establishing communication with the broken surfaces. The degree of infection may be to some extent estimated from the manner of causation of the injury. Compound fractures from direct impact are generally contaminated with soil, grit, or other infective material, and frequently contain particles of skin, hair, and splinters of bone. In rare cases, however, the wound may remain aseptic or practically so, and healing of the external wound may occur by first intention.

When the fractured ends of bone themselves cause the wound, the degree of infection will depend upon the condition and cleanliness of the skin.

Subsequent ulceration may be dependent upon necrosis, mechanical, the result of specific infection, or upon both factors acting simultaneously. Necrosis occurring in contused, unresisting tissues may be very extensive, and is frequently associated with a condition of progressive suppuration, with resulting debility, emaciation, and, in fatal cases, death from toxæmia, pyæmia, or septicæmia. Tetanus is not an uncommon sequel, and in cases of this nature the termination is usually death.

The depth of the wound is also a matter of importance. When the fractured bone is deeply buried under muscles, dangerous hæmorrhage may result; and even if this be not sufficient in itself to cause death, the coagulation of blood in the wound cavity affords an excellent medium for the multiplication of organisms, and gangrene frequently sets in.

Suppuration between and around the fractured ends of the bones is inimical to callus-formation, especially when the medullary tissue becomes infected, which readily occurs.

The nature of the injury must also be considered.

It may be a matter of impossibility to replace the projecting ends of bone, or portions may be broken off, so that shortening of the limb must eventually result. Pieces may be partially loosened or the bone may be fissured in various directions.

Loose pieces may be cast off as sequestra by exfoliation (superficial necrosis), the entire broken end may come away (partial necrosis), or the whole diaphysis of a round bone may undergo necrosis (total necrosis).

After being denuded of its periosteum, the surface of the bone is yellowish in colour. If it remain healthy, in the course of a few days it takes on a bright pink vascular appearance. After a fortnight the surface becomes covered with a layer of fine granulations, which eventually unite with the granulations of the surrounding soft tissues. The resulting cicatrix is therefore adherent to the bone.

Should, however, the parts become infected and healing be thus retarded, portions of bone undergo necrosis. These may appear either pure white, grey, or blackish in appearance, in contrast to the neighbouring pus-covered, granulating tissues. After a period ranging from weeks to months, they become loose and are eventually cast off. The underlying bone will then be found covered by fine granulations, and the back of the sequestrum will show a pitted surface to correspond. It is by no means uncommon for exfoliation of bone to occur three or four weeks after healing of the accompanying wound. This gives rise to abscess-formation and the production of one or multiple fistulæ. The condition persists unless the external opening becomes sufficiently enlarged to permit of the passage of the necrotic portion.

In compound fracture we cannot obtain union whilst unremoved necrosed portions of bone exist between the severed ends. Cicatrization of the surrounding parts is retarded but little by their presence, and by the time that the sequestrum has become free the external wound will have become too small to allow of its exit.

During the operation of docking, should the vertebra be divided instead of the section being made through the joint, sequestrum-formation occurs, with sloughing off of the divided bone at the next articulation.

Treatment.

Compound fractures are usually treated by means of fenestrated bandages. A window may be cut in the plaster or whatever agent may be used to correspond with the wound. Some means must be adopted to keep the ends of the bone immobile and in apposition, and this is usually done by the use of long splints, either of wood or leather, made to lace up. If of wood, the splint must be applied to the side of the limb opposite to the wound. Leather leggings may be cut so as to expose the seat of injury. They are, however, in many cases difficult to keep in position, especially when the fracture is in the region of the thigh or upper part of the arm.

Plating, so common an operation in human surgery, is seldom practised in animals; but with properly constructed sheets of silver or aluminium there is no reason why it should not be attempted in cases which demand extra support to the fractured ends. In small animals aluminium sheeting is of service to support the limb, as it is cleanly, does not retain discharges, and can be readily shaped to the limb. An aperture can be provided over the seat of the injury. Bandaging alone may be sufficient. A number of short strips of linen may be covered with pitch, their centres applied to the side of the limb away from the wound, and their ends brought around the limb above and below it. The disadvantage of this fixed type of bandage is that it becomes saturated with discharges, which also penetrate between it and the skin, causing sloughing and pain.

Various types of "cradles" and mechanical appliances are manufactured for use in the larger animals.

It may be found impossible, even under an anæsthetic, to effect the return of the ends of the bone through the wound. In this case the only alternative is to remove as much of the pointed ends of the bone as may be absolutely necessary with the saw. All loose pieces of bone must be got rid of, but firmly adherent splinters are best left in position. Further treatment depends upon the nature of the injury and the possibility of infection. If soiled with dirt or excreta, the wound should be thoroughly irrigated with warm normal saline solution, and subsequently painted with tinct. iodi or a solution of ol. caryoph. in spts. vini rect. Drainage must be provided for by further incision when necessary, and by packing the wound with loose strips of gauze soaked in sterile normal saline solution.

When suppuration persists, the wound may be washed out with 5 per cent. zinc. chlorid.; frequent flushings with warm saline solution should be persisted in, and careful search must be made for sequestra, which should be removed directly they become sufficiently loose.

Wounds which appear aseptic from their commencement may be covered with gauze and left strictly alone, unless suppuration or necrosis becomes established.

Eusol may be advantageously employed in wounds of bone tissue which become fœtid and unhealthy.

Injury to the bone of the jaw, within the oral cavity, as may be caused by the bit, is usually a difficult condition to treat. Necrosis of the maxilla sets in, and the wound becomes infected with a great variety of bacteria, including those commonly present in the mouth, such as spirillæ and various bacilli. Wounds of this type are especially remarkable for their odour. The necrosis usually extends along the bone beyond the external wound, and may necessitate a further incision of the gum.

Thorough curettage is the sheet-anchor of treatment, followed by the application of tinct. iodi or a mixture of aloes, myrrh, and ol. caryoph., or the occasional use of the caustic pencil. Soft food must be provided, and the use of the bit forbidden. After recovery the latter must be padded or covered with rubber to prevent recurrence of the injury.

Amputation wounds may be met with in canine and feline practice. In cats particularly we may often be called upon to treat wounds caused by the animal being caught in gins laid for rabbits or vermin. These present a great deal of difficulty. The animal repeatedly licks the wound with its rough tongue, and retards healing. It is a very difficult matter to retain bandages or dressings in position, as the animal is capable of repeatedly flicking them off by shaking the limb. Painting the wound with bitter substances, as ext. gentian, or aloes with myrrh or oil of cloves, gives the best results, but recovery is very slow. The flesh of the cat possesses a lesser degree of healing power than does that of any other of the domesticated animals, and the capability which the animal possesses of absorbing poisonous medicaments applied to the skin and of removing the same by means of the tongue is quite unsurpassed.

CHAPTER XV

WAR WOUNDS

GUNSHOT wounds may be divided into the following classes:

1. Bullet wounds.
2. Shell wounds—(*a*) Shrapnel; (*b*) high explosive.

Bullet Wounds.—If situated in muscular tissue, the bullet may remain embedded or may penetrate the muscular tissue and both layers of skin, eventually finding exit in parts such as the region of the crest or the muscle group below the ischial region.

In some cases, presumably when the bullet is clean, the symptoms shown are those of local inflammation, swelling, and pain. This subsides in the course of a few days, and usually gives no further trouble.

Many bullets remain embedded without causing other symptoms than those described. The wound caused by the exit of the bullet is nearly always larger than that caused by its entrance; the latter is, indeed, often very hard to discover.

Bullet wounds occurring in tissues other than muscular are more serious. Should a bone be injured or the bullet become lodged therein, surgical interference is imperative.

Wounds in the abdominal region are nearly always fatal, and symptoms of acute peritonitis are observable in a few hours, as is indicated by fever, head held low to the ground, distressed breathing, very marked injection of the visible mucous membranes, and a frothy discharge from the mouth and nostrils.

Bullet wounds in the pulmonary region are often followed by no ill effects. On the other hand, they may be immediately fatal or death may occur after a few hours, according to the extent of the internal injury.

Infection, as far as we have observed, rarely accompanies wounds caused by bullets. Probably most animals receive the missile directly from the transmitter, without its previously having been soiled by earth or other matters.

It sometimes happens that secondary infection of the channel occurs.

Prognosis depends almost entirely upon the site of the wound.

Treatment.—In cases of muscular penetration probably no special treatment may be required. Slow walking exercise is useful in limb cases, and relief will be afforded by the use of medicated fomentations. Careful attention should be paid to diet.

If the bullet be embedded and can be felt upon palpation, it is advisable to practise extraction. If close to the surface, it may be detected by probing. This usually leads to suppuration of the wound, which is seldom serious, and in the majority of cases healing is uneventful.

If the bullet be found, probing is quite satisfactory and worth the risk of inducing suppuration, but in case its presence cannot be detected, as often occurs when the channel is tortuous, probing is detrimental.

It is the general practice to plug bullet wounds with wool saturated with iodine solution. This procedure is, however, of doubtful value, as it is almost impossible to disinfect the course of the missile, and is often unnecessary, as is shown by the comparative rapidity with which similar wounds heal if left untreated.

Should it happen that the wound is badly infected, local inflammation will show no signs of abatement after a few days, and systemic symptoms may be evident.

Treatment must then be directed towards providing drainage, and disinfection of the wound should be attempted.

Should a joint be seriously injured, it will be better to destroy the animal at once.

Shrapnel Wounds.—The above remarks apply in this case, but as the bullets travel at an angle and usually from above downwards, there is rarely any natural drainage. Thus shrapnel wounds tend to suppurate much more than ordinary bullet wounds. This is also said to be due to the powder (high explosive) clinging to the projectile. It is often a very difficult matter to locate the bullet, which may penetrate to a great distance, and a 15-inch probe in some cases does not reach the end of the wound. These cases usually terminate in the formation of a chronic suppurating sinus, from which exudes a yellow, gelatinous discharge.

If the bullet can be discovered and removed and drainage provided, recovery follows.

Even if it cannot be detected soon after the time of its penetration, it usually happens that after five or six days a natural channel is formed by the discharge of pus, which materially aids attempts at detection by means of the probe.

The above remarks apply particularly to wounds occurring in the croup or gluteal regions, which are common situations of wounds of this class.

When it is possible to remove the bullet, after extraction its channel should be continued in a downward direction through an artificial exit. The wound should then be washed out and plugged.

One of the best antiseptics is hypochlorous acid, prepared by mixing chloride of lime and boracic acid in water and allowing the solution to stand for some time. This gives very good results. The wounds become healthy, free from odour, and granulation rapidly takes place.

Solution of hypochlorous acid appears to give far better results than lysol, iodine, or other antiseptics, and has the advantage of being cheap.

High Explosive.—Owing to the wide range in the shape of the pieces into which a shell splits, wounds thus caused vary greatly.

The portion embedded may be a minute splinter or a huge piece of metal, but the common size is about that of a walnut, sometimes very irregular in shape and rough; at others rectangular and smooth, with sharp edges.

The wounds range in character from huge gaping rents to small sinuses, sometimes shallow, sometimes quite deep, and with a very tortuous channel (caused by the " spin " of the projectile).

The walls are usually very badly bruised and lacerated.

Treatment consists in removal of the foreign body and the provision of drainage. The wound should be dressed with hypochlorous acid and plugged with absorbent wool saturated in the solution.

It is necessary to remove all particles of skin, hair, harness, and foreign material. As these shells usually penetrate the ground before exploding, they carry a great deal of earth into the tissues.

It may at first be difficult to discover the pieces of metal, but after the course of a few days intense suppuration sets in and guides one to the offending body, via the channel which it thus enlarges.

False pockets are often created by the piece of metal in its course through the tissues.

In one case which came under the writer's notice the injury was a lacerated wound about 10 inches long, which assumed a greenish colour and emitted a very offensive odour and discharge, probably indications of gangrene. We have not observed other cases simulating gangrene, but no doubt they occur.

Malignant œdema and septicæmia sometimes set in.

All high-explosive wounds are exceedingly prone to tetanus infection, so that serum should be used whenever possible—indeed, it is advisable to administer a prophylactic dose in all wounds caused by projectiles. When one examines a wound caused by high explosive, one usually observes that the muscle and tissues lining it appear dead to a slight depth. This may be caused by the heat of the piece of shell, which is often too far above body temperature to handle, or by the action of the powder clinging to it.

It is said that an acid is evolved from the latter upon explosion—possibly picric acid (?).

The muscle presents a macerated, semi-boiled appearance, and in place of the usual redness assumes a pale brownish tint.

Necrosis.—This may arise from various causes. During the present war necrosis has been very frequent among all classes of animals, and has been the cause of very severe expense to the country. The condition affects chiefly all animals standing out of doors, although it is by no means uncommon in animals under cover in stables.

The cause is bacillary infection, the gate of entrance being a wound such as a tread or cracked heel, but in many instances there is no obvious seat of origin. Many of these cases occur in horses working on roads in which fascines have been laid over mud, so that puncture is probably the cause of infection. Secondary lesions may occur.

In the early stages there may be no obvious symptoms, although we have observed horses lick and bite a part in which necrosis was present in its initial stages. Later a gradual line of demarcation is seen between the sound and affected tissues; and a very sharp line may exist, the affected parts being of a greenish-brown colour. In the course of a few days sloughing occurs, accompanied by a very offensive odour.

The size of the lesion varies from the size of a pin's head to that of the palm of the hand. Usually the skin and underlying connective tissue are affected, but in severe cases necrosis extends to underlying structures, sometimes involving joint cavities, with death as a sequel. The seats of the lesions are varied. By far the larger number of cases affect the coronets, next the hocks, but the condition is sometimes seen on the neck or other parts of the body.

Treatment.—Remove the hair from the part affected and locate the extent of the lesion; scarify a wide area and well swamp with iodine. Assist removal of the slough as far as possible, and cut off any part separated with scissors; but do not break broken-down tissue, or the slough will not come away in such a clean manner.

Probably the best agents to use are hydrogen peroxide and hypochlorous acid; persistent application of a 5 per cent. warm solution of the latter is very useful.

If the horse can be kept on a clean, dry floor, probably the wound is best left open; cleanliness is essential to success.

In cases affecting the deeper tissues prognosis is often unfavourable, especially if the condition has not been observed or treated during the first few days.

CHAPTER XVI

REMARKS ON THE USE OF VACCINES IN WOUND TREATMENT

THE object of vaccine therapy is to stimulate the production in the body of the particular opsonins required to render the infecting organisms palatable to the phagocytes.

Under given circumstances the use of vaccines is undoubtedly beneficial, but they have so often been employed under conditions in which they could not possibly be of benefit that their reputation has suffered severely in consequence.

In cases of fistula dependent upon the presence of necrotic tissue, and in other instances where wounds refuse to heal through want of drainage, we shall derive no advantage from adopting vaccine treatment; and it may justly be argued that when these conditions have been overcome there is then no need for the assistance of vaccines, as healing will then occur naturally in due course.

If we make a careful microscopical examination of the pus from any wound, particularly from a case of poll-evil or fistulous wither, we are at once struck by the many varieties of organism present. But if at a later date, after all necrotic tissue has been removed, we again make an examination, we shall find in the majority of cases that one particular organism predominates. The inference is that the opsonic index of the patient is low for this particular organism, and we shall probably derive benefit by administering an autogenous vaccine derived from a culture containing it. In other cases the explanation may be that the presence of certain organisms lowers the resistance of the body towards certain other species of organism. For instance, the presence of certain anaerobic bacteria, such as certain streptococci, may be dependent upon cohabitation with aerobes, and by raising the opsonic index to the one we may obtain a natural resistance to the other.

It must be also borne in mind that the power of a vaccine is directly in proportion to the blood-supply of the part which we desire to influence. Also, vaccines prepared from the majority of types of bacilli are not so potent as those obtained from cocci. The value of the vaccine depends upon the presence of endotoxins within the bodies of the bacteria, and those which manufacture exotoxins will not stimulate the production of opsonins when injected, as will those which contain toxins in their interior.

When toxæmia results from wound infection, the administration of an antiserum will greatly increase the benefit derived from the administration of the vaccine.

An autogenous vaccine is almost essential to success in the majority of cases, although in urgent cases there is no objection to the use of a stock vaccine pending the preparation of an autogenous. A stock vaccine, if made use of, should be "polyvalent" in that it contains numerous strains of the same organism, in addition to being "mixed"—that is to say, containing various types of organism. The term "polyvalent," as employed in advertising vaccines, is too frequently misapplied, being written in place of the latter term.

When the surgeon has not the time or facilities to prepare an autogenous vaccine on laboratory principles, a substitute may be made as follows. This method, although not entirely original, has been used by us for several years, and of late has been extensively employed in the treatment of a very large number of hospital cases. When conditions have been suitable we have found that the results equalled those obtained from the use of a laboratory vaccine, and in no case have we observed abscess-formation or systemic symptoms beyond those which accompany natural reaction. The method is as follows:

After cleansing the skin and exterior of the wound with moist pads of cotton-wool, a spoon or spoon curette is introduced into the depths of the wound, and is employed to gently scrape the interior.

We thus procure a fairly pure, clean sample of pus.

We then examine stained slides prepared from this, and endeavour to ascertain the nature of the infection and the comparative scarcity or abundance of the organisms contained therein. This procedure is not essential, but is helpful in estimating dosage.

When several cases of the same nature, such as poll-evil, are to be treated, an equal quantity of pus may be taken from each and mixed. This gives a fairly uniform pus, but it must be remembered that the proportion of organisms from each case is less in the mixed pus than in the separate samples, and so the dose of vaccine prepared from it must be larger.

From 1 to 3 c.c. of pus, according to the prevalence of organisms, should be diluted with from 20 to 30 c.c. of normal saline solution in a test-tube or glass bottle, and thoroughly shaken until the pus is quite broken up and mixed with the saline solution.

Place the tube in a saucepan of water, insert a thermometer within it, and keep it for four hours at a temperature of 120° F., or for one hour at 130° F. The longer period is the better, as it succeeds in drawing out a larger quantity of toxin.

Filter the liquid through a triple layer of sterile gauze several times until any coagulated fragments have been removed. The vaccine should then have a milky appearance. To each 30 c.c. of vaccine add 1 c.c. of 90 per cent. acid. carbol., and allow to stand for one hour at least before use.

The initial dose of a vaccine so prepared may roughly be estimated as 1·5 c.c. This is the dose we have always commenced with, and have never found it too large. The temperature should be taken at the time of injection, and every six hours after for the first forty-eight hours. A rise of 1° to 2° F. indicates that the dose is sufficient, whereas no rise at all shows that the dosage must be increased. The second may be given as soon as the temperature has regained the normal, and should be double the original dose.

The chief disadvantage of this method is that no accurate estimate can be made of the number of organisms of each type present, nor can the total number be known.

On the other hand, even with a vaccine prepared by a " count " we have no means of estimating the correct initial dose for any particular animal, and in each case the thermometer affords the only reliable guide in practice.

CHAPTER XVII

DIETETICS AND HYGIENE

A NOTION exists among stockowners that rich nitrogenous material must not be given to patients under treatment for wounds. This certainly holds good in the case of horses confined in stables and unable to take exercise, and would apply whether a wound were present or not; but in the majority of cases good nourishing food, compatible with the amount of exercise which the animal is able to take, is essential in order to maintain the quality of the blood and its powers of resistance to organisms.

Lymphangitis demands loose, easily digestible food, green fodder and bran, and a liberal quantity of fluid.

Œdematous conditions, on the other hand, require dry food and as little fluid as possible, in order to assist Nature to absorb the exudate.

Wounds of the mouth may receive soft food, as bran mashes or boiled oats and bran and steamed hay. Water should be given after feeding to wash out particles of food from the wound.

Green food, whenever procurable, is a very beneficial adjunct to the ordinary rations of cases suffering from wounds.

Exercise is in very many cases of benefit in the treatment of wounds according to their position and severity. Sometimes, however, as when extensive transverse wounds of muscle tissue are present, exercise may be decidedly harmful, as it may favour the " burrowing " of pus between the muscles and further infection. As other examples may be quoted wounds of joints and transverse wounds of the limbs in the neighbourhood of joints, particularly at the flexure of the knee or hock. Continuous movement causes irritation and the formation of excessive granulations without corresponding increase in the formation of epithelium.

In most cases, however, exercise not only stimulates the body functions, but assists the circulation of blood both locally and generally, mechanically stimulates the flow of lymph, and greatly facilitates drainage. The drainage of wounds involving the fascia of the limbs is greatly assisted by a run at pasture.

The immediate surroundings have an influence upon the healing of wounds. Cold and draught are deleterious, but sunshine and fresh air are markedly advantageous.

Clean bedding and hygienic buildings and floors are also desirable. The best material for bedding is undoubtedly oaten straw; peat moss is quite unsuitable for the purpose.

Occasionally stables may become infected by special organisms, sometimes as a result of their having previously sheltered infected cases. Scirrhous cord and tetanus are instances of conditions dependent upon bacteria which tend to lie dormant.

We have observed three consecutive cases of fatal tetanus occur in one stable. On another occasion a horse became infected with tetanus through a wound caused by a saddle pad. An effort was made to sterilize this before again using it by soaking it in a bath of disinfectant fluid. Nevertheless, the next animal upon which the pad was used developed tetanus, but recovered.

Horses working on sewage farms are very prone to tetanus infection. In one instance which came to our notice, three ponies kept in one stable on a sewage farm developed fatal tetanus. Donkeys were substituted, but appeared no less susceptible, and one died of the disease within three weeks of purchase.

It is advisable to re-line with leather and to renew the flocking of all harness which has been used on infected cases having harness wounds.

Stables in which tetanus has occurred should be sprayed throughout with a disinfectant, treated with the blow-lamp, and subsequently whitewashed or tarred.

INDEX

Abscess, coronary, 122, 130
  formation, 17
Actinomyces, 11, 13
Adhesions, 63
Alum, 56
Amboceptor, 15
Amputation wounds, 176
Anal fistula, 166
Antiseptics, 20, 21, 22
Antiserums, 166
Antitetanic serum, 30, 62
Arsenic, 54
Astringents, 56, 152
Autogenous vaccines, 23

Bacillus anthracis, 4, 17, 29
  coli, 11, 12, 163
  necrosis, 11, 13, 14, 131
  œdematis maligni, 4, 11, 12, 27, 29, 163
  pyocyaneus, 11, 12
  tetani, 11, 27, 29, 123, 163
Bacterial necrosis, 14, 181
Bacteriolysins, 15
Bier's treatment, 46
Black oil, 41
Bloodvessels of the neck, wounds of the, 78
Bothryomyces, 11, 13, 163
Broken knees, 105
Bullet wounds, 176
Burns and scalds, 47
Bursa of the ligamentum nuchæ, inflammation of the, 140
Bursæ and tendon sheaths, wounds of the, 95

Capped hock, suppurating, 117
Carbolic acid, 36
Carpal region wounds of the, 114
Carron oil, 47
Castration wounds, 163
Caustics, 56
  the use of, 54
Cellulitis, 65
  ulcerative, 65, 106
Cervical region, wounds of the, 78
Chemotaxis, negative, 4
Claw-evil, 134
Complement, 15
Complications and sequelæ of wounds, some, 62
Compound fracture, 171
Continuous irrigation, 61
Control of hæmorrhage, 48
Contused wounds, 2
Copper sulphate, 54
Coronary abscess, 121, 130
  band, inflammation of the, 133
Coronet and coronary band, wounds of the, 129
Corpora oryzoidea, 17
Costal sinus, 87
Counter-irritation, 26, 46
Curdy pus, 17
Curettage, 38, 57

Deep wounds, dressing, 38
Dental fistula, 74
Dentigerous cyst, 77
Derivation of lymph, the, 8
Dietetics and hygiene, 187
Disinfection, triple, 37
Dorsal spines, necrosis of the, 150

Drainage tubes, 59
  of wounds, 23, 58
Dressing deep wounds, 38
Dry dressings, 26, 36

Elbow, wounds of the, 101, 102
Eusol, 36, 125, 175
Examination of the wound, 18
Exercise, 187
Eye, wounds of the, 70
Eyelids, wounds of the, 68

Face, wounds of the, 72
Facial region, wounds of the, 68
False nostril and alæ, wounds of the, 71
  quittor, 130
Feet among horses and cattle, wounds of the, 120
Fibromata, 55
Fibrous swelling, 67
First intention, healing by, 3, 7
Fistula, 136
  anal, 166
    complete, 160, 162
    incomplete, 160
  dental, 74
  pre-auricular, 77
  rectal, 162
  salivary, 76
  sternal, 85
  vaginal, 162
Fistula of the inguinal region, 159
    lower jaw, 75
    withers, 148
Fistulæ and sinuses, 136
    treatment of, 138
Flesh, proud, 6
Flexor tendons, wounds of the sheaths of the, 108
Foot bath, 125
Forearm, wounds of the, 103
Fracture of the pedal bone, 129
Fractured ribs, 83
Frog, puncture of the, 126

General treatment of wounds, the, 18
Granulations, 4
Granulation, healing by, the process of, 5
  tissue, 21

Hæmorrhage, control of, 48
Hæmothorax, 82
Head and neck, wounds of the, 68
Healing by first intention, 3, 7
  by granulation, 3
  the process of, 3
  under a scab, 7
  by union of two granulating surfaces, 8
High explosive wounds, 177, 180
Hind limbs, wounds of the, 109
Hydrogen peroxide, 166
Hygiene, dietetics and, 187
Hypochlorous acid, 36

Ichorous pus, 16
Incised wounds, 1
Infection, secondary, 24
  wound, 10
Inferior maxilla, necrosis of, 175
    wounds of the, 74
Inflammation of the bursa of the lig. nuchæ, 140
    coronary band, 133
Inguinal region, fistula of the, 159
Injuries to the interdental space, 74
Inspissated pus, 16
Interdental space, injuries to the, 74
Iodine, 34

Kaolin poultice, 112
Knees, broken, 105

Lacerated wounds, 2
Lead and alum lotion, 42
Lematte's solutions, 34
Limbs, wounds of the, 100
Lower jaw, fistula of the, 75
Lymph, derivation of, 8
Lymphagogues, 8
Lymphangitis, 64

Maggots, 44
Malignant œdema, 39

Mastisol, 37
Mercuric chloride, 54
Metacarpal and phalangeal regions, wounds of the, 106

Nail pricks, 120
Necrosis, bacterial, 14, 181
    of the dorsal spines, 150
        inferior maxilla, 175
        scapular cartilage of prolongation, 151
Negative chemotaxis, 4
Nuclein, 147, 166
Nutrition of wounds, 45

Œdema, 66
Œsophageal wounds, 79
Ointments, 42
Ol. picis, 44
Ol. tereb., 35, 41, 55, 152
Open joint and wounds of bursæ and tendon sheaths, 95
    wounds, 2
Opsonins, 14
    immune, 14
    normal, 14

Panaritium in cattle, 134
Pathology of wounds, 1
Pedal bone, fracture of the, 129
Perforans tendon, resection of the, 129
        wounds of the sheath of the, 118
Perforating abdominal wounds, 89
    wounds of the thorax, 82
Perforatus tendon, wounds of the sheath of the, 117
Peritonitis, 164, 170
Pessaries, uterine, 170
Phlebitis, 66
Picked-up nails, 123
Picric acid, 35, 36
Plantar cushion, puncture of the, 124
Pleurisy, 83, 84
Plugging deep wounds, 40
Pneumothorax, 82, 83
Poll-evil, 140, 185
Potassium permanganate, 37
Pre-auricular fistula, 77
Preliminary disinfection of wounds, 30
Priesz-Nocard bacillus, 66
Process of healing, the, 3
Proud flesh, 6, 55
Puncture of the frog, 126
        plantar cushion, 124
Punctured wounds, 2, 33
Pus, 4, 16
    corpuscles, 16
    curdy, 17
    grumous, 17
    ichorous, 17
    inspissated, 16
    laudable, 16
    sanious, 17
    serous, 17
Pyæmia, 67

Quittor, 123, 152
    false, 130, 152, 158

Rectal fistula, 162
Remarks on the use of vaccines in wound treatment, 183
Resection of the perforans tendon, 129

Saddle and harness wounds, 88
Salivary fistula, 76
Sanious pus, 17
Scab, healing under, 7
Scapular cartilage, necrosis of the, 151
Scar, 5
    tissue, 6, 7
Scarification, 57
Scirrhous cord, 159, 163, 188
Secondary infection, 24
Septicæmia, 67
Serous pus, 17
Shell wounds, 177, 179
Shoulder region, wounds of the, 100
    tumours, 55
Shrapnel wounds, 177, 179
Silver nitrate, 38
Sinus, 136
    costal, 87
    formation, 29

Sitfasts, 88
Skin of the neck, wounds of the, 80
Sole bandage, 121
  wounds of the, 125
Some complications and sequelæ of wounds, 62
Spirillæ, 13
Staphylococci, 11, 12
Staphylococcus albus, 11
  aureus, 11
Sternal fistula, 85
Stifle, wounds of the, 110
Streptococci, 11, 12
Styptics, chemical, 49
  physiological, 49
Subcutaneous bursæ of the hock, wounds of the, 116
Subscapular tissues, wounds of the, 81
Suppurating capped hock, 117
Surgical control of hæmorrhage, 49
Sutures, 50
Swelling, fibrous, 67
Synovial discharge from the foot, 127

Tarsal region, wounds of the, 112
Tetanus, 127, 164, 188, 189
  bacillus, 12
Thermal influence, 48
Thoracic region without perforation, wounds of the, 84
Thrombosis, 66
Tibial region, wounds of the, 110
Tissue, scar, 6, 7
Tongue, wounds of the, 72
Toxæmia, 67
Tracheal region, wounds of the, 78
Triple disinfection, 37
True hock joint, wounds of the, 114
Trunk, wounds of the, 82

Ulcerative cellulitis, 65, 106
Union of two granulating surfaces, healing by, 8
Use of caustics, the, 54
Uterine pessaries, 170
  sutures, 169
  and vaginal wounds, 167

Vaccines, 166
  autogenous, 184
  mixed, 184
  polyvalent, 184
  in wound treatment, remarks on the use of, 183
Vaginal fistula, 162

War wounds, 177
White lotion, 42, 56
Whitlow, 134
Withers, fistula of the, 148
Wound, examination of the, 18
  infection, 11
Wounds, amputation, 176
  bullet, 177
  castration, 163
  contused, 2
  the general treatment of, 18
  high explosive, 177, 180
  incised, 1
  involving bone tissue, 171
  lacerated, 2
  nutrition of, 45
  œsophageal, 79
  open, 2
  pathology of, 1
  preliminary disinfection of, 30
  punctured, 2
  saddle and harness, 88
  shell, 177
  shrapnel, 177, 179
  uterine and vaginal, 167
  war, 177
Wounds of the bloodvessels of the neck, 78
    carpal region, 104
    cervical region, 78
    coronet and coronary band, 129
    elbow, 101
    eye, 70
    eyelids, 68
    face, 72
    facial region, 68

Wounds of the bloodvessels of the
  false nostril and alæ, 71
  forearm, 103
  head and neck, 68
  hind limbs, 109
  inferior maxilla, 74
  limbs, 100
  metacarpal and phalangeal regions, 106
  sheath of the perforans tendon, 118
    perforatus tendon, 117
  sheaths of the flexor tendons, 108, 117, 118
  shoulder region, 100
  skin of the neck, 80
  sole, 125
  the stifle, 110
  subcutaneous bursa of the elbow, 101
  subcutaneous bursa of the hock, 116
  subscapular tissues, 81
  tarsal region, 112
  thoracic region without perforation, 84
  thorax, perforating, 82
  tibial region, 110
  tongue, 73
  tracheal region, 78
  true hock joint, 114
  trunk, 82
Wright's opsonin theory, 14

Zinc chloride, 55

Baillière, Tindall & Cox, 8, Henrietta Street, Covent Garden, London.